# TECHNICAL APPENDIX Modification Application (Call Sign E140087) Astronics AeroSat Corporation

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### I. <u>Technical Description</u>

### A. Proposed Operations

### 1. Overview

Astronics AeroSat's FliteStream<sup>TM</sup> Ku-band aeronautical broadband system is comprised of earth station aboard aircraft ("ESAA") equipment, leased capacity on commercial fixed-satellite service ("FSS") satellites and an associated ground segment. Astronics AeroSat has previously provided the Commission a detailed description of the operational characteristics of the FliteStream<sup>TM</sup> system and network technology<sup>1</sup> and, except as indicated in this application, no further changes are proposed thereto.

Astronics AeroSat seeks to operate its previously licensed HR6400 ESAA terminal with certain additional satellite points of communication. <sup>2</sup> Additionally, Astronics AeroSat seeks to operate its HR129 "tail mount" ESAA terminal<sup>3</sup> with the FliteStream<sup>TM</sup> system while communicating with certain U.S. and non-U.S. licensed satellites.

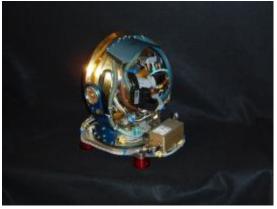
### B. HR129 Terminal

### 1. Technical Parameters

Operated in the same way as Astronics AeroSat's currently authorized HR6400 terminal, HR129 terminal is an tail-mounted ESAA terminal that enables Astronics AeroSat to provide two-way broadband communications in commercially available Ku-band FSS spectrum to smaller business aviation aircraft consistent with the Commission's ESAA rules, 47 C.F.R. §25.227, and other applicable Commission rules and policies. The HR129 terminal is shown in Figure 1 and the basic characteristics of the HR129 terminal are summarized in Tables 1 and 2, below.

Figure 1: HR129 Terminal





Side View Back View

<sup>&</sup>lt;sup>1</sup> See Astronics AeroSat Corporation, File No. SES-LIC-20140902-00688 (Call Sign E140087), Technical Appendix.

<sup>&</sup>lt;sup>2</sup> The technical characteristics of the HR6400 Ku-band terminal previously described to the Commission have not change and Astronics AeroSat incorporates by reference the technical information provided with its original ESAA blanket license application. *See generally* File No. SES-LIC-20140902-00688 (Call Sign E140087).

<sup>&</sup>lt;sup>3</sup> The HR129 terminal is also known as Astronics AeroSat's T-200 Series antenna system.

Table 1 – Summary of Technical Parameters (HR129)

Parameter	Performance
Antenna Diameter	29 cm
Type of Antenna	Circular Rexolite®
	Fresnel lens
Peak Power (SSPA)	25 watts
Gain	28.9 dBi @ 10.7 GHz
	30.4 dBi @ 12.75 GHz
	31.1 dBi @ 14.0 GHz
	31.3 dBi @ 14.5 GHz
EIRP	41.9 dBW @ 14.5 GHz
Transmit Frequency Range	14.0 GHz to 14.5 GHz
Receive G/T (15°K Sky	10.0 dB/K @ 10.7 GHz
Temperature)	11.5 dB/K @ 12.75 GHz
Receive Frequency Range	10.7 GHz to 12.75 GHz
Receive Bandwidth	2050 MHz
	(10.7-12.75 GHz)
Polarization	Linear Tx/Dual Pol Rx,
	Dual Pol Circular Rx only

Table 2 – Summary of Control Parameters (HR129)

Azimuth	Continuous, 360°
Elevation	0° to 90°
Pointing Accuracy	
Azimuth:	0.2°
Elevation:	0.2°
Azimuth, Elevation,	7.0° sec
Polarization Rates of	
Change	
Azimuth, Elevation,	$7.0^{\circ} \text{ sec}^2$
Polarization	
Acceleration	

### 2. HR129 Terminal Components and Characteristics

The HR129 Ku-band terminal is comprised of the following components:

- Antenna Tail Mount Unit ("TMU")
- Antenna Control and Modem Unit ("ACMU")
- Low Power Transceiver ("LPT")
- Power Amplifier Unit ("PAU")
- Diplexer

The TMU affixes the terminal to the aircraft tail and has been certified for in-flight use. The terminal will not transmit until it receives the appropriate outbound signal from the satellite and it has validated antenna pointing within  $0.2^{\circ}$  and will cease transmission immediately in certain instances to avoid causing interference.

The ACMU controls the antenna pointing accuracy to a pointing error of less than  $0.2^{\circ}$  between the target satellite and the axis of the antenna's main lobe. The ACMU continuously monitors the pointing error and will mute the transmitter if the pointing error exceeds  $0.5^{\circ}$ . All emissions automatically cease within 100 milliseconds if the angle between the orbital location of the target satellite and the axis of the main lobe of the antenna exceeds  $0.5^{\circ}$ , and transmission is not resumed until the pointing error is less than  $0.2^{\circ}$ .

The terminal also will cease transmissions automatically in the following instances:

• If the ACMU loses communication with the aircraft inertial navigation system ("INS"), or

- If the modem loses receive signal, or
- If there is a failure of the ACMU itself, or
- If the reference oscillator fails.

The LPT allows accurate power control, and the ACMU ensures compliance with applicable power spectral density ("PSD") limits. The power detector within the LPT is stable over frequency and temperature and reports the Ku-band transmit power from the PAU. In this way, Astronics AeroSat can maintain accurate power control at the PAU output regardless of variations in PAU gain over temperature and frequency.

### 3. Off-Axis EIRP Spectral Density

Astronics AeroSat is applying for ESAA operating authority under Section 25.227(a)(2) of the Commission's Rules because it proposes to operate the HR129 terminal with certain satellite points of communication at off-axis EIRP spectral density levels in excess of those specified in Section 25.227(a)(1). Accordingly, Astronics AeroSat has included satellite operator certifications and other technical information required by Section 25.227(b)(2).

Nonetheless, Astronics AeroSat will conduct HR129 operations in the United States consistent with the off-axis EIRP spectral density levels along the geostationary arc specified in Section 25.227(a)(1) (i.e., consistent with two-degree spacing levels). Astronics AeroSat will control off-axis EIRP spectral density emissions from the HR129 terminal through limitations on the transmit power spectral density and control of pointing error.

### 4. Satellite Points of Communication for HR129 Terminal

Astronics AeroSat will utilize commercial Ku-band FSS capacity for its proposed commercial operations. Astronics AeroSat seeks to operate the HR129 terminals with the following satellite points of communication:

Table 3 – HR129 Terminal Proposed Satellite Points of Communication

Satellite	Licensing Admin.	Orbital Location	Downlink Freq. (GHz) <sup>4</sup>	ITU Region Coverage Area	Serves U.S. <sup>5</sup>
Anik G1	Canada	107.3°	11.7-12.2	R2	No
Apstar 6	China	134° E	10.7-12.75	R3	No
Apstar 7	China	76.5° E	11.45-11.7	R1, R3	No
Asiasat 5	China	100.5° E	11.45-12.2	R1	No
Eutelsat 10A (W2A)	France	10° E	12.5-12.75	R1	No
Eutelsat 70B	France	70.5° E	10.95-11.7; 12.5-12.75	R1, R3	No

<sup>&</sup>lt;sup>4</sup> ESAA uplinks will be operated in all or part of the 14.0-14.5 GHz band depending on available capacity and national/regional restrictions on Ku-band aeronautical uplink operations.

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<sup>&</sup>lt;sup>5</sup> "Yes" indicates that the relevant satellite will be used for ESAA operations in U.S. territory. "No" indicates that ESAA operations will be conducted outside U.S. territory, even if the satellite may have some coverage of the United States.

Satellite	Licensing Admin.	Orbital Location	Downlink Freq. (GHz) <sup>4</sup>	ITU Region Coverage Area	Serves U.S. <sup>5</sup>
Eutelsat 115WB (Satmex 7)	Mexico	114.9°W	11.7-12.2	R2	Yes
Eutelsat 117WA	Mexico	116.8°W	11.7-12.2	R2	No
Eutelsat 172A	U.S.	172° E	10.95 - 11.2; 11.45 - 11.7; 12.2 - 12.75	R2, R3	No
IS-14	U.S.	45° W	11.45-11.7	R1, R2	No
IS-15 (JCSAT-85)	U.S.	85° E	12.5-12.75	R1, R2	No
IS-29E	U.S.	50° W	10.95-12.5	R1, R2	Yes
JCSAT-5A	Japan	132° E	12.25-12.75	R3	No
NSS-6	Netherlands	95° E	11.45-11.7; 12.5-12.75	R3	No
Superbird C2	Japan	144° E	12.2-12.75	R3	No
Telstar 11N	U.S.	37.5° W	10.95 - 11.2; 12.25 - 12.75	R1	No
Telstar 12V	U.S.	15° W	10.95-12.2	R1, R2	No
Yamal 300K	Netherlands	183° E	10.95-11.7	R1, R2	Yes
Yamal 401	Russia	90° E	10.95-11.2; 11.45-12.75	R1, R3	No

The operational coverage area maps and link budgets for each of the foregoing satellites are included in the Technical Appendix.

Each satellite operator has reviewed and confirmed that Astronics AeroSat's proposed commercial operations of the HR129 terminal are consistent with the satellite operator's coordination agreements and will not result in unacceptable interference to other satellite operations within +/-6 degrees of each satellite. Letters from each satellite operator confirming these conclusions are included in the Technical Appendix.

### 5. Gateway Earth Stations

As indicated in Table 2 below, the gateway earth stations for the Astronics AeroSat network are located in various countries around the world to provide global coverage. The earth stations include an iDirect hub (consisting of a DVB-S2 modulator and an iDirect D-TDMA demodulator) and are connected to Astronics AeroSat's network control facilities.

**Table 4 – Gateway Earth Stations** 

Satellite	Satellite Operator	Gateway Earth Station Location	Country	Gateway Operator	FCC Call Sign
Anik G1	Telesat	Lima	Peru	NewCom	N/A
Apstar 6	APT	Beijing	China	ChinaTelecom Satellite	N/A
Apstar 7	APT	Ortuchhio	Italy	Telespazio	N/A
Asiasat 5	Asiasat	Kofinou	Cyprus	Stellar	N/A
Eutelsat 10A (W2A)	Eutelsat	Cologne	Germany	Stellar	N/A
Eutelsat 70B	Eutelsat	Kofinou	Cyprus	Stellar	N/A
Eutelsat 115WB (Satmex 7)	Eutelsat Americas	Brewster, WA	U.S.	USEI	S2938
Eutelsat 117WA	Eutelsat Americas	Houston, TX	U.S.	Harris CapRock	E030279
Eutelsat 172A	Eutelsat	Brewster, WA	U.S.	USEI	E910548
IS-14	Intelsat	Aberdeen	U.K.	Harris CapRock	N/A
IS-15 (JCSAT-85)	Intelsat	Kofinou	Cyprus	Stellar	S2789
IS-29E	Intelsat	Hagerstown, MD	U.S.	Intelsat	S2913
JCSAT-5A	SPJSAT	Yokohama	Japan	SPJSAT	N/A
NSS-6	SES	Kofinou	Cyprus	Stellar	N/A
Superbird C2	SPJSAT	Hong Kong	China	PCCW	N/A
Telstar 11N	Telesat	Melbourne, FL	U.S.	Harris CapRock	S2357
Telstar 12V (MW, MC, ME, MN)	Skynet	Mt. Jackson, VA	U.S.	Telesat	S2933
Telstar 12V (NS)	Skynet	Chalfont	U.K.	Arqiva	S2933
Yamal 300K	Gazprom	Brewster, WA	U.S.	USEI	E120043
Yamal 401	Gazprom	Moscow	Russia	RuSat	N/A

### C. HR6400 Terminal

The technical characteristics of the HR6400 Ku-band terminal have been previously described to the Commission and Astronics AeroSat incorporates by reference the technical information provided with its original ESAA blanket license application. Although Astronics AeroSat has included satellite operator certifications as required by Section 25.227(b)(2), it intends to conduct operations in the United States with the relevant Table 1 satellites consistent with the off-axis EIRP

spectral density levels along the geostationary arc specified in Section 25.227(a)(1) (i.e., consistent with two-degree spacing levels).

As previously demonstrated by Astronics AeroSat, the off-axis EIRP spectral density of the HR6400 Ku-band terminal will comply with the FCC's two-degree spacing policies as set forth in Section 25.227(a)(1) of the FCC Rules at all operational skew angles from 0-55° when operating in the United States. The maximum input power into the antenna has been selected to ensure compliance at the maximum skew angle of 55°.

The terminal will not transmit until it receives the appropriate outbound signal from the satellite and it has validated antenna pointing within  $0.2^{\circ}$  and will cease transmission immediately in certain instances to avoid causing interference.

As with the HR129 terminal, each satellite operator has reviewed and confirmed that Astronics AeroSat's proposed HR6400 operations are consistent with the satellite operator's coordination agreements and will not result in unacceptable interference to other satellite operations within +/-6 degrees of each satellite. Letters from each satellite operator confirming these conclusions, in addition to link budgets for each satellite, are included in the Technical Appendix. Astronics AeroSat also provides the FCC Form 312 and Schedule B for information that is changing as a result of the requested modification. Astronics AeroSat proposes to communication with the following fourteen (14) satellite points of communications:

- Anik G1
- Apstar 6
- Asiasat 5
- Eutelsat 10A
- Eutelsat 70B
- Eutelsat 115WB
- IS-15
- IS-29E
- JCSAT-5A
- NSS-6
- Superbird C2
- Telstar 12V
- Yamal 300K
- Yamal 401

### D. Network Control

Network control of Astronics AeroSat's proposed commercial operations will be provided pursuant to Astronics AeroSat's direction and control from a Network Operations Center ("NOC") in Amherst, New Hampshire, through its network control partner, Panasonic, who will provide managed network services to Astronics AeroSat. The NOC will be responsible for configuring, monitoring, controlling, and, if necessary, preventing transmissions from any HR129 or HR6400 terminal. The NOC will be staffed at all times, providing continuous supervision and monitoring of such operations. In addition, network control personnel will be accessible to address any operational issues.

<sup>&</sup>lt;sup>6</sup> See Table 3 and Table 4 for relevant satellite and gateway earth station information.

### Primary Point of Contact:

Networks Operations Center Coordinator

Office: +1 (603) 879-0205 Fax: +1 (603) 386-6488

Company Address:

Astronics AeroSat Corporation Suite #2B 62 New Hampshire 101A

Amherst, NH 03031

Email Address: NOC@astronics.com

### Secondary Point of Contact:

Panasonic Avionics Corporation Mission Control Center 26200 Enterprise Way Lake Forest, CA 92630

Office: (425) 415-9800

Email Address: mcc@panasonic.aero

### E. Geographic Area(s) of the ESAA Network

The Astronics AeroSat's FliteStream<sup>TM</sup> system will operate globally with in the service area of the satellites/beams identified herein. The figure below provides the notional coverage over the global network (with example flight city-pair routes). The Technical Appendix provides detailed service areas for each serving satellite.

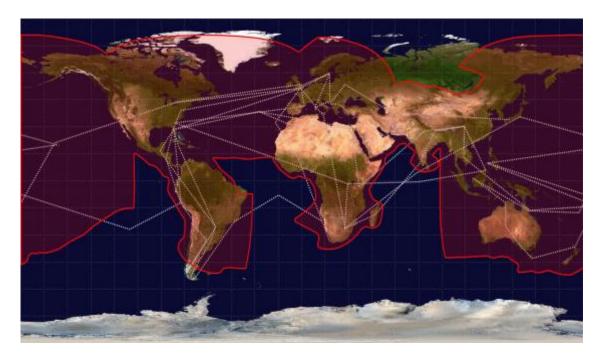


Figure 2: Geographic Coverage of ESAA Network

# II. Proposed Satellite Points of Communication

### 1. ANIK G1

### Coverage Map



### **Satellite Operator Certification Letter**



Telesat, 1601 Telesat Court Ottawa, ON, Canada K1B 5P4 27 May 2016

Federal Communications Commission International Bureau 445 12<sup>th</sup> Street SW Washington, DC 20554

Re: Engineering Certification for Astronics AeroSat

To Whom It May Concern:

This letter certifies that Telesat is aware that Astronics AeroSat Corporation ("Astronics AeroSat") is planning to seek authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAA") terminals to communicate with the Anik G1, Telstar 12V, and Telstar 11N satellites which are located at 107.3°W, 15°W, and 37.5°W, respectively. Specifically, we understand that Astronics AeroSat seeks to operate two types of Ku-band antennas, HR6400 antenna and HR129 antenna, for communication with these satellites for commercial purposes consistent with the FCC's Part 25 rules, including Section 25.227.

Based on the information provided by Astronics AeroSat, Telesat understands the technical characteristics of the HR6400 and HR129 antennas and Telesat (i) recognizes that operation of these terminals at the power density levels provided to Telesat is consistent with the existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from Anik G1, Telstar 12V, and Telstar 11N; (ii) acknowledges that the proposed operation of these terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable; and (iii) if the FCC authorizes the operations proposed by Astronics AeroSat, Telesat will take into consideration the power density levels associated with such operations in all future satellite network coordinations with adjacent satellite operators.

Sincerely,

BAHRAM BORNA

Satellite Spectrum Coordination Engineer

Telesat

### **Link Budgets**

Return Link Budget

-119.7 dBW/m2 -92.0 dBW/m2 2.5 dB 25.2 dB 12.000 GHz 51.0 dBW 47.0 dBW 13.2 dBW/4kHz -6.1 dBW/4kHz 26.2 dBW 22.2 dBW 36936 km 205.4 dB 0.0 dB 2.2 dB 0.0 dB 0.0 dB 79.3 dBHz 78.8 dBHz 65.4 dBHz

#### Forward Link Budget

Flitestream		Flitestream	
Antenna Type	HR6400	Antenna Type	HR6400
Lat	-0.8 deg	Lat	-0.8 deg
Lon	-79.4 deg	Lon	-79.4 deg
G/T	12.1 dB/K	EIRP max	45.0 dBW
Satellite		Satellite	
Name	Anik-G1	Name	Anik-G1
Longitude	-107.3 deg	Longitude	-107.3 deg
Hub Earth Station		Hub Earth Station	
Site	Peru	Site	Peru
Lat	-12.092 deg	Lat	-12.092 deg
Lon	-77.027 deg	Lon	-77.027 deg
EIRP max	81.4 dBW	G/T	36.1 dB/K
Signal	21/2 02/21/2	Signal	· D
Waveform	DVB-S2 iDX2	Waveform	iDirect BPSK
Modulation	QPSK 2	Modulation	BP5K 1
Bits per symbol Spread Factor	1	Bits per symbol Spread Factor	4
Coding Rate	0.60	Coding Rate	0.53
Overhead Rate	0.60	Overhead Rate	0.53
Channel Spacing	1.20	Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.20 1.13 bps/Hz	Spectral Efficiency (Rate/Noise BW)	0.10 bps/Hz
Data Rate	2.69E+07 bps	Data Rate	6.37E+05 bps
Information Rate (Data + Overhead)	2.86E+07 bps	Information Rate (Data + Overhead)	8.87E+05 bps
Symbol Rate	2.38F+07 Hz	Symbol Rate	1.67E+06 Hz
Chip Rate (Noise Bandwidth)	2.38E+07 Hz	Chip Rate (Noise Bandwidth)	6.66E+06 Hz
Occupied Bandwidth	2.86E+07 Hz	Occupied Bandwidth	7.99E+06 Hz
Power Equivelent Bandwidth	3.60E+07 Hz	C/N Threshold	-4.4 dB
C/N Threshold	2.7 dB	Uplink	4.4 00
Uplink	2.7 00	Frequency	14.250 GHz
Frequency	14.250 GHz	Back off	2.0 dB
Back off	6.5 dB	EIRP Spectral Density	10.8 dBW/4kH
EIRP Spectral Density	37.1 dBW/4kHz	Slant Range	36647 km
Slant Range	36936 km	Space Loss, Ls	206.8 dB
Space Loss, Ls	206.9 dB	Pointing Loss, Lpnt	0.1 dB
Pointing Loss, Lpnt	0.0 dB	Atmosphere / Weather Loss, La	0.0 dB
Atmosphere / Weather Loss, La	1.6 dB	Radome, Lr	0.0 dB
Radome, Lr	0.0 dB	Transponder G/T @ Terminal	1.0 dB/K
Transponder G/T @ Hub	1.0 dB/K	Thermal Noise, C/No	65.7 dBHz
Thermal Noise, C/No	96.0 dBHz	C/(No+lo)	65.6 dBHz
C/(No+lo)	95.5 dBHz	Satellite	
Satellite	<u> </u>	Flux Density	-119.7 dBW/m2
Flux Density	-89.0 dBW/m2	SFD @ Terminal	-92.0 dBW/m2
SFD @ Hub	-89.0 dBW/m2	Small Signal Gain (IBO/OBO)	2.5 dB
Small Signal Gain (IBO/OBO)	0.0 dB	ОВО	25.2 dB
ОВО	0.0 dB	Downlink	
Downlink		Frequency	12.000 GHz
Frequency	12.000 GHz	Transponder Sat. EIRP @ Beam Peal	51.0 dBW
Transponder Sat. EIRP @ Beam Peal	51.0 dBW	Transponder Sat. EIRP @ Hub	47.0 dBW
Transponder Sat. EIRP @ Terminal	47.0 dBW	DL PSD Limit	13.2 dBW/4kH
DL PSD Limit	13.2 dBW/4kHz	DL PSD @ Beam Peak	-6.1 dBW/4kH
DL PSD @ Beam Peak	13.2 dBW/4kHz	Carrier EIRP @ Beam Peak	26.2 dBW
Carrier EIRP @ Beam Peak	51.0 dBW	Carrier EIRP @ Hub	22.2 dBW
Carrier EIRP @ Terminal	47.0 dBW	Slant Range	36936 km
Slant Range	36647 km	Space Loss, Ls	205.4 dB
Space Loss, Ls	205.3 dB	Pointing Loss, Lpnt	0.0 dB
Pointing Loss, Lpnt	0.1 dB	Atmosphere / Weather Loss, La	2.2 dB
Atmosphere / Weather Loss, La	0.0 dB	Radome, Lr	0.0 dB
Radome, Lr	0.0 dB	PCMA Loss	0.0 dB
PCMA Loss	0.0 dB	Thermal Noise, C/No	79.3 dBHz
Thermal Noise, C/No	82.2 dBHz	C/(No+lo)	78.8 dBHz
C/(No+lo)	80.8 dBHz	End to End	
End to End		End to End C/(No+lo)	65.4 dBHz
End to End C/(No+lo)	80.7 dBHz	Implementation Loss	0.0 dB
Implementation Loss	1.0 dB	End to End C/N w/ Imp Loss	-2.8 dB
End to End C/N w/ Imp Loss	5.9 dB	Link Margin	1.6 dB
Link Margin	3.2 dB		

#### Forward Link Budget

#### Return Link Budget

eXConnect Terminal		eXConnect Terminal	
Antenna Type	HR129	Antenna Type	HR129
Lat	5.8 deg	Lat	5.8 deg
Lon	-75.2 deg	Lon	-75.2 deg
EIRP max	42.1 dBW	EIRP max	42.1 dBW
G/T	11.2 dB/K	G/T	11.2 dB/K
Satellite		Satellite	
Name	Anik-G1	Name	Anik-G1
Longitude	-107.3 deg	Longitude	-107.3 deg
Hub Earth Station		Hub Earth Station	
Site	Lima	Site	Lima
Lat	12.092 deg	Lat	12.092 deg
Lon	-77.027 deg	Lon	-77.027 deg
EIRP max	80.0 dBW	EIRP max	80.0 dBW
G/T	36.1 dB/K	G/T	36.1 dB/K
Signal		Signal	
Waveform	DVB-S2	Waveform	iDirect
Modulation	QPSK	Modulation	BPSK
Bits per symbol	2	Bits per symbol	1
Spread Factor	1	Spread Factor	4
Coding Rate	0.75	Coding Rate	0.67
Overhead Rate	0.92	Overhead Rate	0.72
Channel Spacing	1.20	Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.39 bps/Hz	Spectral Efficiency (Rate/Noise BW)	0.12 bps/Hz
Data Rate	4.16E+07 bps	Data Rate	8.05E+05 bps
Information Rate (Data + Overhead)	4.50E+07 bps	Information Rate (Data + Overhead)	1.11E+06 bps
Symbol Rate	3.00E+07 Hz	Symbol Rate	1.67E+06 Hz
Chip Rate (Noise Bandwidth)	3.00E+07 Hz	Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	3.60E+07 Hz	Occupied Bandwidth	8.00E+06 Hz
Power Equivelent Bandwidth	3.60E+07 Hz	Power Equivelent Bandwidth	3.36E+05 Hz
C/N Threshold	4.4 dB	C/N Threshold	-4.2 dB
Uplink		Uplink	
Frequency	14.300 GHz	Frequency	14.140 GHz
Back off	1.5 dB	Back off	0.0 dB
EIRP Spectral Density	39.8 dBW/4kHz	EIRP Spectral Density	9.9 dBW/4kHz
Slant Range	36942 km	Slant Range	36956 km
Space Loss, Ls	206.9 dB	Space Loss, Ls	206.8 dB
Pointing Loss, Lpnt	0.0 dB	Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	6.7 dB	Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB	Radome, Lr	0.5 dB
Transponder G/T @ Hub	-1.0 dB/K	Transponder G/T @ Terminal	3.0 dB/K
Thermal Noise, C/No	92.5 dBHz	Thermal Noise, C/No	66.3 dBHz
C/(No+lo)	92.0 dBHz	C/(No+lo)	65.8 dBHz
Satellite		Satellite	
Flux Density	-90.5 dBW/m2	Flux Density	-120.8 dBW/m2
SFD @ Hub	-87.0 dBW/m2	SFD @ Terminal	-94.0 dBW/m2
Small Signal Gain (IBO/OBO)	2.5 dB	Small Signal Gain (IBO/OBO)	2.5 dB
OBO	1.0 dB	ОВО	24.3 dB
Downlink		Downlink	
Frequency	12.000 GHz	Frequency	11.840 GHz
Transponder Sat. EIRP @ Beam Peak	51.0 dBW	Transponder Sat. EIRP @ Beam Peak	51.0 dBW
Transponder Sat. EIRP @ Terminal	50.0 dBW	Transponder Sat. EIRP @ Hub	47.0 dBW
DL PSD Limit	13.2 dBW/4kHz	DL PSD Limit	13.2 dBW/4kH
DL PSD @ Beam Peak	11.2 dBW/4kHz	DL PSD @ Beam Peak	-5.6 dBW/4kH
Carrier EIRP @ Beam Peak	50.0 dBW	Carrier EIRP @ Beam Peak	26.7 dBW
Carrier EIRP @ Terminal	49.0 dBW	Carrier EIRP @ Hub	22.7 dBW
Slant Range	36956 km	Slant Range	36942 km
Space Loss, Ls	205.4 dB	Space Loss, Ls	205.3 dB
Pointing Loss, Lpnt	0.0 dB	Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB	Atmosphere / Weather Loss, La	7.6 dB
Radome, Lr	0.5 dB	Radome, Lr	0.0 dB
		PCMA Loss	0.0 dB
	0.0 dB		
PCMA Loss	82.9 dBHz	Thermal Noise, C/No	74.6 dBHz
PCMA Loss Thermal Noise, C/No	82.9 dBHz	* *	
PCMA Loss Thermal Noise, C/No C/(No+Io)		C/(No+lo)	74.6 dBHz 71.6176 dBHz
PCMA Loss Thermal Noise, C/No C/(No+lo) End to End	82.9 dBHz 80.9 dBHz	C/(No+lo) End to End	71.6176 dBHz
PCMA Loss Thermal Noise, C/No C/(No+lo) <b>End to End</b> End to End C/(No+lo)	82.9 dBHz 80.9 dBHz 80.6 dBHz	C/(No+lo)  End to End  End to End C/(No+lo)	71.6176 dBHz 64.8 dBHz
PCMA Loss Thermal Noise, C/No C/(No+lo) End to End	82.9 dBHz 80.9 dBHz	C/(No+lo) End to End	71.6176 dBHz

# 2. APSTAR 6

### Coverage Map



### **Satellite Operator Certification Letter**



亞太通信衛星有限公司 APT SATELLITE COMPANY LIMITED

July 11, 2016

Federal Communications Commission International Bureau 445 12th Street, S.W. Washington, D.C. 20554

Re: Engineering Certification of APT Satellite Company Limited for Astronics AeroSat

To Whom It May Concern:

This letter certifies that APT Satellite Company Limited ("APT Satellite") is aware that Astronics AeroSat Corporation ("AeroSat") is planning to seek authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAAs") – the HR6400 terminal and HR129 terminal – with the APSTAR-6 Satellite at 134° E.L. and with the APSTAR-7 Satellite at 76.5° E.L. AeroSat seeks to operate the HR129 and HR6400 terminals with these satellites for commercial purposes consistent with the FCC's ESAA rules, including Section 25.227.

Based on the information provided by AeroSat, APT Satellite understands the technical characteristics of the HR6400 and HR129 terminals, and APT Satellite (i) recognizes that operation of these terminals at the power density levels provided to APT Satellite is consistent with existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from APSTAR-6 and APSTAR-7; (ii) acknowledges that the proposed operation of these terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable; and (iii) if the FCC authorizes the operations proposed by AeroSat, APT Satellite will take into consideration the power density levels associated such operations in all future satellite network coordinations with adjacent satellite operators.

Sincerely,

Brian LO

Vice President & Company Secretary APT Satellite Company Limited

nuido

Date

July 11, 2016

### **Link Budgets**

### Forward Link Budget

Site	Hong Kong	
Antenna Type	HR6400	
Lat	22.1	
Lon	113.2	
G/T Satellite	12.3	dB/K
Name	APSTAR-6	
Transponder	K2	
Longitude	134.0	deg
Hub Earth Station		
Site	HongKong4_5m	
Lat	22.45	
Lon	114.18	deg dBW
EIRP max Signal	80.0	UBVV
Waveform	DVB-S2	
Modulation	16APSK	
Bits per symbol	4	
Spread Factor	1	
Coding Rate	0.80	
Overhead Rate	0.91	
Channel Spacing	1.20	bps/Hz
Spectral Efficiency (Rate/Noise BW) Data Rate	2.92 6.73E+07	
Information Rate (Data + Overhead)	7.36E+07	
Symbol Rate	2.30E+07	
Chip Rate (Noise Bandwidth)	2.30E+07	
Occupied Bandwidth	2.76E+07	Hz
C/N Threshold	11.5	dB
Uplink	44.050000	
Frequency Power Control Mode	14.063000 Automatic Uplink Power	
Back off	10.8	
EIRP Spectral Density		dBW/4kH
Slant Range	36754	
Space Loss, Ls	206.7	dB
Pointing Loss, Lpnt	0.0	dB
Atmosphere / Weather Loss, La	3.8	
Radome, Lr	0.0	
Transponder G/T @ Hub		dB/K
Thermal Noise, C/No C/(No+lo)		dBHz dBHz
Satellite	33.4	UDITZ
Flux Density	-96.9	dBW/m2
SFD @ Hub		dBW/m2
Small Signal Gain (IBO/OBO)	2.5	dB
OBO	3.0	dB
Downlink	42.245000	
Frequency	12.315000	dBW
Transponder Sat. EIRP @ Beam Pea Transponder Sat. EIRP @ Terminal		dBW
DL PSD Limit		dBW/4kH
DL PSD @ Beam Peak		dBW/4kH
Carrier EIRP @ Beam Peak		dBW
Carrier EIRP @ Terminal		dBW
Slant Range	36776	
Space Loss, Ls	205.6	
Pointing Loss, Lpnt Atmosphere / Weather Loss, La	0.1 0.0	
Radome, Lr	0.0	
PCMA Loss	0.0	
Thermal Noise, C/No		dBHz
C/(No+lo)		dBHz
End to End		
End to End C/(No+Io)		dBHz
Implementation Loss	0.0	
End to End C/N w/ Imp Loss Link Margin	12.4	
LINK MARKIN	0.9	αB

#### Return Link Budget

Return Lii	nk Budget	
Flitestream Terminal		
Site	Hong Kong	
Antenna Type	HR6400	
Lat	22.1	deg
Lon	113.2	
EIRP max	44.9	dBW
Satellite Name	APSTAR-6	
Name Transponder	APSTAK-6 K2	
Longitude	134.0	deg
Hub Earth Station	154.0	ись
Site	HongKong4_5m	
Lat	22.45	deg
Lon	114.18	deg
G/T	29.9	dB/K
Signal		
Waveform	iDirectRL-SF4	
Modulation Bits per symbol	QPSK 2	
Spread Factor	1	
Coding Rate	0.79	
Overhead Rate	0.90	
Channel Spacing	1.20	
Spectral Efficiency (Rate/Noise BW	) 1.43	bps/Hz
Data Rate	6.55E+06	
Information Rate (Data + Overhead		
Symbol Rate	4.50E+06	
Chip Rate (Noise Bandwidth)	4.50E+06	
Occupied Bandwidth	5.40E+06	
C/N Threshold Uplink	6.6	иь
Frequency	14.077000	GH <sub>7</sub>
Power Control Mode	Automatic Uplink Powe	
Back off	0.0	
EIRP Spectral Density	14.4	dBW/4kH
Slant Range	36776	
Space Loss, Ls	206.7	
Pointing Loss, Lpnt	0.1	
Atmosphere / Weather Loss, La Radome, Lr	0.0	
Transponder G/T @ Terminal		dB/K
Thermal Noise, C/No	74.7	
C/(No+lo)	74.6	
Satellite		
Flux Density	-115.2	dBW/m2
SFD @ Terminal		dBW/m2
Small Signal Gain (IBO/OBO)	2.5	
OBO	21.3	dB
Downlink Frequency	12.329000	CU <sub>2</sub>
Frequency Transponder Sat. EIRP @ Beam Pea		
Transponder Sat. EIRP @ Hub	55.0	
DL PSD Limit		dBW/4kF
DL PSD @ Beam Peak		dBW/4kH
		dBW
Carrier EIRP @ Beam Peak		
Carrier EIRP @ Hub	31.4	
Carrier EIRP @ Hub Slant Range	31.4 36754	km
Carrier EIRP @ Hub Slant Range Space Loss, Ls	31.4 36754 205.6	km dB
Carrier EIRP @ Hub Slant Range Space Loss, Ls Pointing Loss, Lpnt	31.4 36754 205.6 0.0	km dB dB
Carrier EIRP @ Hub Slant Range Space Loss, Ls Pointing Loss, Lpnt Atmosphere / Weather Loss, La	31.4 36754 205.6 0.0 4.4	km dB dB dB
Carrier EIRP @ Hub Slant Range Space Loss, Ls Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr	31.4 36754 205.6 0.0 4.4 0.0	km dB dB dB dB
Carrier EIRP @ Beam Peak Carrier EIRP @ Hub Slant Range Space Loss, Ls Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr Thermal Noise, C/No	31.4 36754 205.6 0.0 4.4 0.0 80.0	km dB dB dB dB dBHz
Carrier EIRP @ Hub Slant Range Space Loss, Ls Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr Thermal Noise, C/No C/(No+10)	31.4 36754 205.6 0.0 4.4 0.0	km dB dB dB dB dBHz
Carrier EIRP @ Hub Slant Range Space Loss, Ls Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr Thermal Noise, C/No C/(No+lo) End to End	31.4 36754 205.6 0.0 4.4 0.0 80.0 79.9	km dB dB dB dB dBHz dBHz
Carrier EIRP @ Hub Slant Range Space Loss, Ls Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr Thermal Noise, C/No C/(No+Io) End to End End to End C/(No+Io)	31.4 36754 205.6 0.0 4.4 0.0 80.0 79.9	km dB dB dB dB dBHz dBHz
Carrier EIRP @ Hub Slant Range Space Loss, Ls Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr Thermal Noise, C/No C/(No+lo) End to End	31.4 36754 205.6 0.0 4.4 0.0 80.0 79.9	km dB dB dB dB dBHz dBHz dBHz

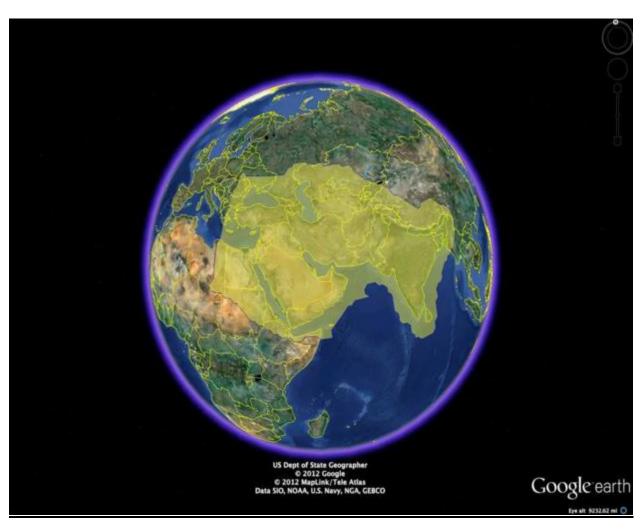
#### Forward Link Budget

#### Return Link Budget

eXConnect Terminal Antenna Type Lat Lon EIRP max G/T Satellite Name Longitude Hub Earth Station Site Lat Lon EIRP max G/T	HR129 24.9 deg 120.8 deg 42.0 dBW 12.3 dB/K  APSTAR-6 134.0 deg	eXConnect Terminal  Antenna Type  Lat  Lon  EIRP max  G/T  Satellite  Name	HR129 24.9 deg 120.8 deg 42.0 dBW 12.3 dB/K
Lat Lon EIRP max G/T Satellite Name Longitude Hub Earth Station Site Lat Lon EIRP max	24.9 deg 120.8 deg 42.0 dBW 12.3 dB/K APSTAR-6 134.0 deg	Lat Lon EIRP max G/T Satellite Name	24.9 deg 120.8 deg 42.0 dBW
Lon EIRP max G/T Satellite Name Longitude Hub Earth Station Site Lat Lon EIRP max	120.8 deg 42.0 dBW 12.3 dB/K APSTAR-6 134.0 deg	Lon EIRP max G/T Satellite Name	120.8 deg 42.0 dBW
EIRP max G/T Satellite Name Longitude Hub Earth Station Site Lat Lon EIRP max	42.0 dBW 12.3 dB/K APSTAR-6 134.0 deg	EIRP max G/T Satellite Name	42.0 dBW
G/T Satellite Name Longitude Hub Earth Station Site Lat Lon EIRP max	12.3 dB/K  APSTAR-6 134.0 deg	G/T Satellite Name	
Satellite Name Longitude Hub Earth Station Site Lat Lon EIRP max	APSTAR-6 134.0 deg	Satellite Name	
Longitude  Hub Earth Station  Site Lat Lon EIRP max	134.0 deg		
Hub Earth Station Site Lat Lon EIRP max	, in the second		APSTAR-6
Site Lat Lon EIRP max	Doiling	Longitude	134.0 deg
Lat Lon EIRP max	Railing	Hub Earth Station	
Lon EIRP max	Beijing	Site	Beijing
EIRP max	22.45 deg	Lat	22.45 deg
	114.18 deg	Lon	114.18 deg
G/T	80.0 dBW	EIRP max	80.0 dBW
	37.3 dB/K	G/T	37.3 dB/K
Signal		Signal	
Waveform	DVB-S2	Waveform	iDirect
Modulation	16APSK	Modulation	BPSK
Bits per symbol	4	Bits per symbol	1
Spread Factor	1	Spread Factor	1
Coding Rate	0.67	Coding Rate	0.75
Overhead Rate	0.94	Overhead Rate	0.81
Channel Spacing	1.20	Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	2.50 bps/Hz	Spectral Efficiency (Rate/Noise BW)	0.61 bps/Hz
Data Rate	7.49E+07 bps	Data Rate	4.04E+06 bps
Information Rate (Data + Overhead)	8.00E+07 bps	Information Rate (Data + Overhead)	5.00E+06 bps
Symbol Rate	3.00E+07 Hz	Symbol Rate	6.67E+06 Hz
Chip Rate (Noise Bandwidth)	3.00E+07 Hz	Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	3.60E+07 Hz	Occupied Bandwidth	8.00E+06 Hz
Power Equivelent Bandwidth	3.60E+07 Hz	Power Equivelent Bandwidth	6.47E+05 Hz
C/N Threshold	9.6 dB	C/N Threshold	3.3 dB
Uplink		Uplink	
Frequency	14.383 GHz	Frequency	14.063 GHz
Back off	3.5 dB	Back off	0.0 dB
EIRP Spectral Density	37.8 dBW/4kHz	EIRP Spectral Density	9.8 dBW/4kHz
Slant Range	36760 km	Slant Range	36663 km
Space Loss, Ls	206.9 dB	Space Loss, Ls	206.7 dB
Pointing Loss, Lpnt	0.0 dB	Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	5.8 dB	Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB	Radome, Lr	0.5 dB
Transponder G/T @ Hub	8.0 dB/K	Transponder G/T @ Terminal	10.0 dB/K
Thermal Noise, C/No	100.5 dBHz	Thermal Noise, C/No	73.3 dBHz
C/(No+lo)	100.0 dBHz	C/(No+Io)	72.8 dBHz
Satellite		Satellite	
Flux Density	-91.5 dBW/m2	Flux Density	-120.9 dBW/m2
SFD @ Hub	-88.0 dBW/m2	SFD @ Terminal	-97.9 dBW/m2
Small Signal Gain (IBO/OBO)	2.5 dB	Small Signal Gain (IBO/OBO)	2.5 dB
ОВО	1.0 dB	ово	20.5 dB
Downlink		Downlink	
Frequency	12.635 GHz	Frequency	12.315 GHz
Transponder Sat. EIRP @ Beam Peak	59.3 dBW	Transponder Sat. EIRP @ Beam Peak	59.3 dBW
Transponder Sat. EIRP @ Terminal	57.0 dBW	Transponder Sat. EIRP @ Hub	56.0 dBW
DL PSD Limit	19.7 dBW/4kHz	DL PSD Limit	19.7 dBW/4kHz
DL PSD @ Beam Peak	19.5 dBW/4kHz	DL PSD @ Beam Peak	6.6 dBW/4kHz
Carrier EIRP @ Beam Peak	58.3 dBW	Carrier EIRP @ Beam Peak	38.8 dBW
Carrier EIRP @ Terminal	56.0 dBW	Carrier EIRP @ Hub	35.5 dBW
Slant Range	36663 km	Slant Range	36760 km
Space Loss, Ls	205.8 dB	Space Loss, Ls	205.6 dB
Pointing Loss, Lpnt	0.0 dB	Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB	Atmosphere / Weather Loss, La	6.4 dB
Radome, Lr	0.5 dB	Radome, Lr	0.0 dB
PCMA Loss	0.0 dB	PCMA Loss	0.0 dB
Thermal Noise, C/No	90.6 dBHz	Thermal Noise, C/No	89.5 dBHz
C/(No+lo)	86.0 dBHz	C/(No+lo)	77.7669 dBHz
End to End		End to End	
End to End C/(No+lo)	85.8 dBHz	End to End C/(No+Io)	71.6 dBHz
, , ,	1.0 dB	Implementation Loss	0.0 dB
Implementation Loss			
Implementation Loss End to End C/N w/ Imp Loss	10.0 dB	End to End C/N w/ Imp Loss	3.4 dB

# *3. APSTAR 7*

### Coverage Map



### **Satellite Operator Certification Letter**



亞太通信衛星有限公司 APT SATELLITE COMPANY LIMITED

July 11, 2016

Federal Communications Commission International Bureau 445 12th Street, S.W. Washington, D.C. 20554

Re: Engineering Certification of APT Satellite Company Limited for Astronics AeroSat

To Whom It May Concern:

This letter certifies that APT Satellite Company Limited ("APT Satellite") is aware that Astronics AeroSat Corporation ("AeroSat") is planning to seek authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAAs") – the HR6400 terminal and HR129 terminal – with the APSTAR-6 Satellite at 134° E.L. and with the APSTAR-7 Satellite at 76.5° E.L. AeroSat seeks to operate the HR129 and HR6400 terminals with these satellites for commercial purposes consistent with the FCC's ESAA rules, including Section 25.227.

Based on the information provided by AeroSat, APT Satellite understands the technical characteristics of the HR6400 and HR129 terminals, and APT Satellite (i) recognizes that operation of these terminals at the power density levels provided to APT Satellite is consistent with existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from APSTAR-6 and APSTAR-7; (ii) acknowledges that the proposed operation of these terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable; and (iii) if the FCC authorizes the operations proposed by AeroSat, APT Satellite will take into consideration the power density levels associated such operations in all future satellite network coordinations with adjacent satellite operators.

Sincerely,

Brian LO

Vice President & Company Secretary APT Satellite Company Limited

nuido

Date

July 11, 2016

### **Link Budget**

#### Forward Link Budget

eXConnect Terminal	
Antenna Type	HR129
Lat	18.0 deg
Lon	34.8 deg
EIRP max	42.1 dBW
G/T	11.8 dB/K
Satellite	
Name	APSTAR-7
Longitude	76.5 deg
<b>Hub Earth Station</b>	

Site	Cyprus
Lat Lon	34.92 deg
Lon	33.64 deg
EIRP max	80.0 dBW
G/T	38.5 dB/K
Signal	

Signal	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.67
Overhead Rate	0.94
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.26 bps/Hz
Data Rate	2.51E+07 bps
Information Rate (Data + Overhead)	2.67E+07 bps
Symbol Rate	2.00E+07 Hz
Chip Rate (Noise Bandwidth)	2.00E+07 Hz
Occupied Bandwidth	2.40E+07 Hz
Power Equivelent Bandwidth	3.60E+07 Hz
C/N Threshold	3.5 dB

Uplink	
Frequency	14.272 GHz
Back off	3.6 dB
EIRP Spectral Density	39.4 dBW/4kHz
Slant Range	38671 km
Space Loss, Ls	207.3 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	2.6 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	2.0 dB/K
Thermal Noise, C/No	97.1 dBHz
C/(No+lo)	96.6 dBHz
Carallina.	

Satemite	
Flux Density	-89.0 dBW/m2
SFD @ Hub	-84.0 dBW/m2
Small Signal Gain (IBO/OBO)	4.0 dB
ОВО	1.0 dB
Downlink	

DOWIIIIIK		
Frequency	12.522	GHz
Transponder Sat. EIRP @ Beam Peak	50.0	dBW
Transponder Sat. EIRP @ Terminal	49.0	dBW
DL PSD Limit	13.0	dBW/4kHz
DL PSD @ Beam Peak	12.0	dBW/4kHz
Carrier EIRP @ Beam Peak	49.0	dBW
Carrier EIRP @ Terminal	48.0	dBW
Slant Range	37905	km
Space Loss, Ls	206.0	dB
Pointing Loss, Lpnt	0.0	dB
Atmosphere / Weather Loss, La	0.0	dB
Radome, Lr	0.5	dB
PCMA Loss	0.0	dB
Thermal Noise, C/No	81.9	dBHz
C/(No+lo)	77.7	dBHz
End to End		

End to End C/(No+lo)	77.7 dBHz
Implementation Loss	1.0 dB
End to End C/N w/ Imp Loss	3.7 dB
Link Margin	0.2 dB

#### Return Link Budget

exconnect reminal	
Antenna Type	HR129
Lat	18.0 deg
Lon	34.8 deg
EIRP max	42.1 dBW
G/T	11.8 dB/K

Satellite	
Name	APSTAR-7
Longitude	76.5 deg

Hub Earth Station	
Site	Cyprus
Lat	34.92 deg
Lon	33.64 deg
EIRP max	80.0 dBW
G/T	38.5 dB/K

Signal		
Waveform	iDirect	
Modulation	BPSK	
Bits per symbol	1	
Spread Factor	4	
Coding Rate	0.67	
Overhead Rate	0.72	
Channel Spacing	1.20	
Spectral Efficiency (Rate/Noise BW)	0.12 bps/Hz	
Data Rate	8.05E+05 bps	
Information Rate (Data + Overhead)	1.11E+06 bps	
Symbol Rate	1.67E+06 Hz	
Chip Rate (Noise Bandwidth)	6.67E+06 Hz	
Occupied Bandwidth	8.00E+06 Hz	
Power Equivelent Bandwidth	1.80E+05 Hz	
C/N Threshold	-4.2 dB	

Uplink	
Frequency	14.272 GHz
Back off	0.0 dB
EIRP Spectral Density	9.9 dBW/4kHz
Slant Range	37905 km
Space Loss, Ls	207.1 dB
Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
Transponder G/T @ Terminal	4.0 dB/K
Thermal Noise, C/No	67.0 dBHz
C/(No+Io)	66.5 dBHz

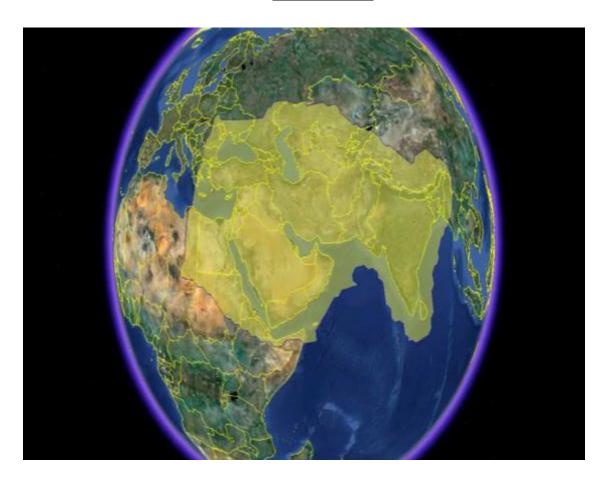
Satemite	
Flux Density	-121.0 dBW/m2
SFD @ Terminal	-92.0 dBW/m2
Small Signal Gain (IBO/OBO)	3.0 dB
ОВО	26.0 dB

Downlink	
Frequency	12.522 GHz
Transponder Sat. EIRP @ Beam Peak	48.0 dBW
Transponder Sat. EIRP @ Hub	48.0 dBW
DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	-10.3 dBW/4kHz
Carrier EIRP @ Beam Peak	22.0 dBW
Carrier EIRP @ Hub	22.0 dBW
Slant Range	38671 km
Space Loss, Ls	206.2 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	3.7 dB
Radome, Lr	0.0 dB
PCMA Loss	0.0 dB
Thermal Noise, C/No	79.2 dBHz
C/(No+Io)	71.5985 dBHz

End to End	
End to End C/(No+lo)	65.4 dBHz
Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	-2.9 dB
Link Margin	1.3 dB

# 4. ASIASAT 5

### Coverage Map



### **Satellite Operator Certification Letter**



TM21-280616-047

28 June 2016

Federal Communications Commission International Bureau 445 12<sup>th</sup> Street, S.W. Washington, D.C. 20554

Re: Engineering Certification of Asia Satellite Telecommunication Co. Ltd.

To Whom It May Concern:

This letter certifies that Asia Satellite Telecommunication Co. Ltd. (hereafter "AsiaSat") is aware that Astronics AeroSat Corporation ("AeroSat") is planning to seek authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAA") terminals with the AsiaSat 5 satellite located at 100.5° E.L. Specifically, we understand that in addition to the previously authorized HR6400 Ku-band ESAA terminal, AeroSat seeks to operate the HR129 terminal (also manufactured by AeroSat) with this satellite for commercial purposes consistent with the FCC's ESAA rules, including Section 25.227.

Based on the information provided by AeroSat, AsiaSat understands the technical characteristics of the new HR6400 and HR129 terminals (manufactured by AeroSat) and AsiaSat

- recognizes that operation of these terminals at the power density levels provided to AsiaSat is consistent with existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from AsiaSat 5;
- acknowledges that the proposed operation of these terminals has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable; and
- (iii) if the FCC authorizes the operations proposed by AeroSat, AsiaSat will take into consideration the power density levels associated such operations in all future satellite network coordination with adjacent satellite operators.

Sincerely,

Yathung CHAN Spectrum Management



### **Link Budgets**

#### Forward Link Budget

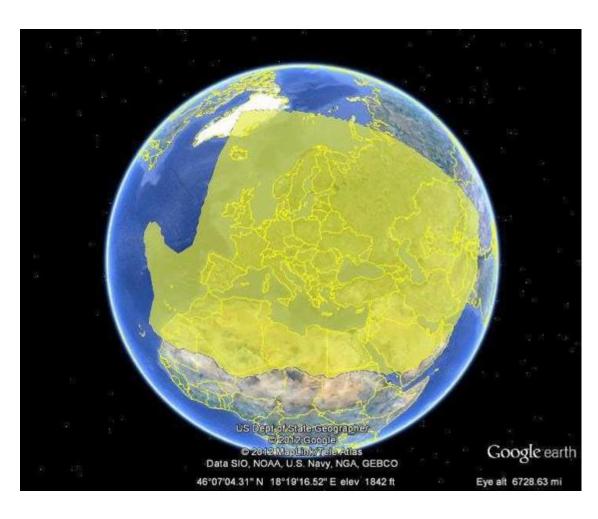
Flitestream Terminal		
Site	Jerusalem	
Antenna Type	HR6400	
Lat	32.4	deg
Lon	35.1	
G/T		dB/K
Satellite		
Name	Asiasat-5	
Transponder	K4V	
Longitude	100.5	deg
Hub Earth Station		
Site	Dubai	
Lat	25.25	deg
Lon	55.31	
EIRP max		dBW
Signal		
Waveform	DVB-S2	
Modulation	QPSK	
Bits per symbol	2	
Spread Factor	1	
Coding Rate	0.33	
Overhead Rate	0.92	
Channel Spacing	1.20	
Spectral Efficiency (Rate/Noise BW)		bps/Hz
Data Rate	2.75E+07	
Information Rate (Data + Overhead)	3.00E+07	
*	4.50E+07	
Symbol Rate Chip Rate (Noise Randwidth)	4.50E+07	
Chip Rate (Noise Bandwidth)		
Occupied Bandwidth	5.40E+07	
C/N Threshold	-0.8	ав
Uplink	44.400200	CII-
Frequency	14.188300	
Power Control Mode	Automatic Uplink P	
Back off	9.8	
EIRP Spectral Density		dBW/4kHz
Slant Range	38418	
Space Loss, Ls	207.2	
Pointing Loss, Lpnt	0.0	
Atmosphere / Weather Loss, La	1.2	
Radome, Lr	0.0	
Transponder G/T @ Hub		dB/K
Thermal Noise, C/No		dBHz
C/(No+lo)	91.6	dBHz
Satellite		
Flux Density		dBW/m2
SFD @ Hub		dBW/m2
Small Signal Gain (IBO/OBO)	3.0	
OBO	3.0	dB
Downlink		
Frequency	12.440300	GHz
Transponder Sat. EIRP @ Beam Peak	52.5	dBW
Transponder Sat. EIRP @ Terminal	48.0	dBW
DL PSD Limit	15.0	dBW/4kHz
DL PSD @ Beam Peak	9.0	dBW/4kHz
Carrier EIRP @ Beam Peak		dBW
Carrier EIRP @ Terminal		dBW
Slant Range	40366	km
	206.5	
Space Loss, Ls	0.1	
	3.1	
Pointing Loss, Lpnt	0.0	
Pointing Loss, Lpnt Atmosphere / Weather Loss, La	0.0	dB
Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr	0.0	
Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss	0.0 0.0	dB
Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No	0.0 0.0 79.4	dB dBHz
Space Loss, Ls Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo)	0.0 0.0 79.4	dB
Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo) End to End	0.0 0.0 79.4 79.0	dB dBHz dBHz
Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo) End to End End to End C/(No+lo)	0.0 0.0 79.4 79.0	dB dBHz dBHz dBHz
Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo) End to End End to End C/(No+lo) Implementation Loss	0.0 0.0 79.4 79.0 78.8 1.0	dB dBHz dBHz dBHz dB
Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo) End to End End to End C/(No+lo)	0.0 0.0 79.4 79.0	dBHz dBHz dBHz dBHz dB

Return Link E	Budget	
Flitestream Terminal Site	Jerusalem	
Antenna Type	HR6400	
Lat	32.4 deg	
Lon	35.1 deg	
EIRP max	45.0 dBW	
Satellite		
Name	Asiasat-5	
Transponder	K4V	
Longitude	100.5 deg	
Hub Earth Station	5.1.1	
Site Lat	Dubai	
Lon	25.25 deg 55.31 deg	
G/T	34.1 dB/K	
Signal	54.1 db/N	
Waveform	iDirectRL-SF8	
Modulation	BPSK	
Bits per symbol	1	
Spread Factor	4	
Coding Rate	0.43	
Overhead Rate	0.68	
Channel Spacing	1.20	
Spectral Efficiency (Rate/Noise BW) Data Rate	0.07 bps/	HZ
Information Rate (Data + Overhead)	4.85E+05 bps 7.18E+05 bps	
Symbol Rate	1.67E+06 Hz	
Chip Rate (Noise Bandwidth)	6.66E+06 Hz	
Occupied Bandwidth	8.00E+06 Hz	
C/N Threshold	-5.0 dB	
Uplink		
Frequency	14.197600 GHz	
Power Control Mode	Automatic Uplink Power Contr	ol
Back off	0.0 dB	
EIRP Spectral Density	12.8 dBW	/4kH
Slant Range	40366 km	
Space Loss, Ls Pointing Loss, Lpnt	207.6 dB 0.1 dB	
Atmosphere / Weather Loss, La	0.1 dB 0.0 dB	
Radome, Lr	0.0 dB	
Transponder G/T @ Terminal	2.0 dB/K	
Thermal Noise, C/No	67.9 dBHz	Z
C/(No+lo)	67.7 dBHz	Z
Satellite		
Flux Density	-120.8 dBW	
SFD @ Terminal	-87.7 dBW	/m2
Small Signal Gain (IBO/OBO)	3.0 dB	
OBO Downlink	30.1 dB	
Frequency	12.449600 GHz	
Transponder Sat. EIRP @ Beam Peak	52.5 dBW	
Transponder Sat. EIRP @ Hub	49.0 dBW	
DL PSD Limit	15.0 dBW	/4kH
DL PSD @ Beam Peak	-7.2 dBW	/4kH
Carrier EIRP @ Beam Peak	25.0 dBW	
Carrier EIRP @ Hub	21.5 dBW	
Slant Range	38414 km	
Space Loss, Ls	206.0 dB	
Pointing Loss, Lpnt	0.0 dB	
Atmosphere / Weather Loss, La Radome, Lr	1.5 dB 0.0 dB	
PCMA Loss	0.0 dB	
Thermal Noise, C/No	76.7 dBHz	,
C/(No+lo)	75.9 dBHz	
End to End	75.5 40112	
End to End C/(No+Io)	67.1 dBHz	Z
Implementation Loss	0.0 dB	
	0.0 dB -1.2 dB	

Forward Link Budget		Return Link Budget		
eXConnect Terminal		eXConnect Terminal		
Antenna Type	HR129	Antenna Type	HR129	
Lat	25.8 deg	Lat	25.8 deg	
Lon	89.9 deg	Lon	89.9 deg	
EIRP max	42.0 dBW	EIRP max	42.0 dBW	
G/T	11.8 dB/K	G/T	11.8 dB/K	
Satellite	· ·	Satellite	,	
Name	Asiasat-5	Name	Asiasat-5	
Longitude	100.5 deg	Longitude	100.5 deg	
Hub Earth Station	100.5 deg	Hub Earth Station	100.5 466	
Site	Cyprus	Site	Cyprus	
		Lat		
Lat	34.92 deg		34.92 deg	
Lon	33.64 deg	Lon	33.64 deg	
EIRP max	80.0 dBW	EIRP max	80.0 dBW	
G/T	37.3 dB/K	G/T	37.3 dB/K	
Signal		Signal		
Waveform	DVB-S2	Waveform	iDirect	
Modulation	QPSK	Modulation	BPSK	
Bits per symbol	2	Bits per symbol	1	
Spread Factor	1	Spread Factor	4	
Coding Rate	0.83	Coding Rate	0.67	
Overhead Rate	0.93	Overhead Rate	0.72	
Channel Spacing	1.20	Channel Spacing	1.20	
Spectral Efficiency (Rate/Noise BW)	1.56 bps/Hz	Spectral Efficiency (Rate/Noise BW)	0.12 bps/Hz	
Data Rate	3.12E+07 bps	Data Rate	8.05E+05 bps	
Information Rate (Data + Overhead)	· ·		1.11E+06 bps	
· '	3.33E+07 bps 2.00E+07 Hz	Information Rate (Data + Overhead)	•	
Symbol Rate		Symbol Rate	1.67E+06 Hz	
Chip Rate (Noise Bandwidth)	2.00E+07 Hz	Chip Rate (Noise Bandwidth)	6.67E+06 Hz	
Occupied Bandwidth	2.40E+07 Hz	Occupied Bandwidth	8.00E+06 Hz	
Power Equivelent Bandwidth	4.79E+07 Hz	Power Equivelent Bandwidth	1.88E+05 Hz	
C/N Threshold	5.6 dB	C/N Threshold	-4.2 dB	
Uplink		Uplink		
Frequency	14.210 GHz	Frequency	14.150 GHz	
Back off	0.0 dB	Back off	0.0 dB	
EIRP Spectral Density	43.0 dBW/4kHz	EIRP Spectral Density	9.8 dBW/4kHz	
Slant Range	40562 km	Slant Range	36649 km	
Space Loss, Ls	207.7 dB	Space Loss, Ls	206.7 dB	
Pointing Loss, Lpnt	0.0 dB	Pointing Loss, Lpnt	0.1 dB	
Atmosphere / Weather Loss, La	8.1 dB	Atmosphere / Weather Loss, La	0.0 dB	
Radome, Lr	0.0 dB	Radome, Lr	0.5 dB	
Transponder G/T @ Hub	2.0 dB/K	Transponder G/T @ Terminal	4.0 dB/K	
	94.9 dBHz		•	
Thermal Noise, C/No		Thermal Noise, C/No	67.2 dBHz	
C/(No+lo)	94.4 dBHz	C/(No+lo)	66.7 dBHz	
Satellite		Satellite		
Flux Density	-91.2 dBW/m2	Flux Density	-120.9 dBW/m2	
SFD @ Hub	-87.7 dBW/m2	SFD @ Terminal	-90.3 dBW/m2	
Small Signal Gain (IBO/OBO)	2.0 dB	Small Signal Gain (IBO/OBO)	3.0 dB	
ОВО	1.5 dB	ОВО	27.6 dB	
Downlink		Downlink		
Frequency	12.462 GHz	Frequency	12.402 GHz	
Transponder Sat. EIRP @ Beam Peak	52.5 dBW	Transponder Sat. EIRP @ Beam Peak	52.5 dBW	
Transponder Sat. EIRP @ Terminal	51.0 dBW	Transponder Sat. EIRP @ Hub	48.0 dBW	
DL PSD Limit	15.0 dBW/4kHz	DL PSD Limit	15.0 dBW/4kHz	
DL PSD @ Beam Peak	13.9 dBW/4kHz	DL PSD @ Beam Peak	-7.4 dBW/4kHz	
Carrier EIRP @ Beam Peak	50.9 dBW	Carrier EIRP @ Beam Peak	24.9 dBW	
Carrier EIRP @ Terminal	49.5 dBW	Carrier EIRP @ Hub	20.4 dBW	
Slant Range	36649 km	Slant Range	40562 km	
I =		5		
Space Loss, Ls		ISpace Loss Ls		
Bointing Loca Lant	205.6 dB	Space Loss, Ls	206.5 dB	
Pointing Loss, Lpnt	205.6 dB 0.0 dB	Pointing Loss, Lpnt	0.0 dB	
Atmosphere / Weather Loss, La	205.6 dB 0.0 dB 0.0 dB	Pointing Loss, Lpnt Atmosphere / Weather Loss, La	0.0 dB 9.4 dB	
Atmosphere / Weather Loss, La Radome, Lr	205.6 dB 0.0 dB 0.0 dB 0.5 dB	Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr	0.0 dB 9.4 dB 0.0 dB	
Atmosphere / Weather Loss, La Radome, Lr PCMA Loss	205.6 dB 0.0 dB 0.0 dB 0.5 dB 0.0 dB	Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss	0.0 dB 9.4 dB 0.0 dB 0.0 dB	
Atmosphere / Weather Loss, La Radome, Lr	205.6 dB 0.0 dB 0.0 dB 0.5 dB	Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr	0.0 dB 9.4 dB 0.0 dB	
Atmosphere / Weather Loss, La Radome, Lr PCMA Loss	205.6 dB 0.0 dB 0.0 dB 0.5 dB 0.0 dB	Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss	0.0 dB 9.4 dB 0.0 dB 0.0 dB	
Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No	205.6 dB 0.0 dB 0.0 dB 0.5 dB 0.0 dB 83.7 dBHz	Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No	0.0 dB 9.4 dB 0.0 dB 0.0 dB 70.4 dBHz	
Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo)	205.6 dB 0.0 dB 0.0 dB 0.5 dB 0.0 dB 83.7 dBHz	Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo)	0.0 dB 9.4 dB 0.0 dB 0.0 dB 70.4 dBHz	
Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo) End to End	205.6 dB 0.0 dB 0.0 dB 0.5 dB 0.0 dB 83.7 dBHz 79.8 dBHz	Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo) End to End	0.0 dB 9.4 dB 0.0 dB 0.0 dB 70.4 dBHz 68.0842 dBHz	
Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo) End to End End to End C/(No+lo)	205.6 dB 0.0 dB 0.0 dB 0.5 dB 0.0 dB 83.7 dBHz 79.8 dBHz	Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo) End to End End to End C/(No+lo)	0.0 dB 9.4 dB 0.0 dB 0.0 dB 70.4 dBHz 68.0842 dBHz	
Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo) End to End End to End C/(No+lo) Implementation Loss	205.6 dB 0.0 dB 0.0 dB 0.5 dB 0.0 dB 83.7 dBHz 79.8 dBHz 79.7 dBHz 1.0 dB	Pointing Loss, Lpnt Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo) End to End End to End C/(No+lo) Implementation Loss	0.0 dB 9.4 dB 0.0 dB 0.0 dB 70.4 dBHz 68.0842 dBHz 64.3 dBHz	

### 5. EUTELSAT 10A

### Coverage Map



### **Satellite Operator Certification Letter**



June 9th, 2016

Federal Communications Commission International Bureau 445 12<sup>th</sup> Street, S.W. Washington, D.C. 20554

Re: Engineering Certification of Eutelsat

To Whom It May Concern:

This letter certifles that Eutelsat is aware that Astronics AeroSat Corporation ("Astronics AeroSat") is planning to seek authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAA") terminals with the Eutelsat 70B satellite at 70.5°E and the Eutelsat 10A satellite at 10°E. Eutelsat understands that Astronics AeroSat seeks to operate the previously authorized HR6400 Ku-band antenna systems with these satellites for commercial purposes consistent with the FCC's ESAA rules, including Section 25.227.

Eutelsat confirms and hereby certifies the following with respect to the ESAA terminal operations proposed by Astronics AeroSat:

- The proposed Ku-band operation of Astronics AeroSat's ESAA terminal has the potential to create harmful interference to adjacent satellite networks that may be unacceptable;
- Eutelsat capacity on the Eutelsat 70B and Eutelsat 10A satellites is used for other ESAA operations;
- c) The proposed operation of the Astronics AeroSat terminals at the proposed power density levels is consistent with existing satellite coordination agreements with the satellites of the Eutelsat 70B and Eutelsat 10A satellites.

If the FCC authorizes the operation proposed by Astronics AeroSat, Eutelsat will include the power density levels specified by Astronics AeroSat, defined within the satellite coordination agreements, in all future satellite network coordination with operators of satellite that are adjacent to those satellites addressed by this letter.

Sincerely,

For Eutelsat

Filipe De Oliveira

Director of Resources Engineering

cedia



June 9th, 2016

Federal Communications Commission International Bureau 445 12<sup>th</sup> Street, S.W. Washington, D.C. 20554

#### Re: Engineering Certification of Eutelsat

To Whom It May Concern:

This letter certifies that Eutelsat is aware that Astronics AeroSat Corporation ("Astronics AeroSat") is planning to seek authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAA") terminals with the Eutelsat 70B satellite at 70.5°E, Eutelsat 172A satellite at 172.0°E and the Eutelsat 10A satellite at 10°E. Eutelsat understands that Astronics AeroSat seeks to operate the previously authorized HR129 Ku-band antenna systems with these satellites for commercial purposes consistent with the FCC's ESAA rules, including Section 25.227.

Eutelsat confirms and hereby certifies the following with respect to the ESAA terminal operations proposed by Astronics AeroSat:

- The proposed Ku-band operation of Astronics AeroSat's ESAA terminal has the potential to create harmful interference to adjacent satellite networks that may be unacceptable;
- Eutelsat capacity on the Eutelsat 70B, Eutelsat 172A and Eutelsat 10A satellites is used for other ESAA operations;
- c) The proposed operation of the Astronics AeroSat terminals at the proposed power density levels is consistent with existing satellite coordination agreements with the satellites of the Eutelsat 70B, Eutelsat 172A and Eutelsat 10A satellites.

If the FCC authorizes the operation proposed by Astronics AeroSat, Eutelsat will include the power density levels specified by Astronics AeroSat, defined within the satellite coordination agreements, in all future satellite network coordination with operators of satellite that are adjacent to those satellites addressed by this letter.

Sincerely,

For Eutelsat Filipe De Oliveira

Director of Resources Engineering

### **Link Budgets**

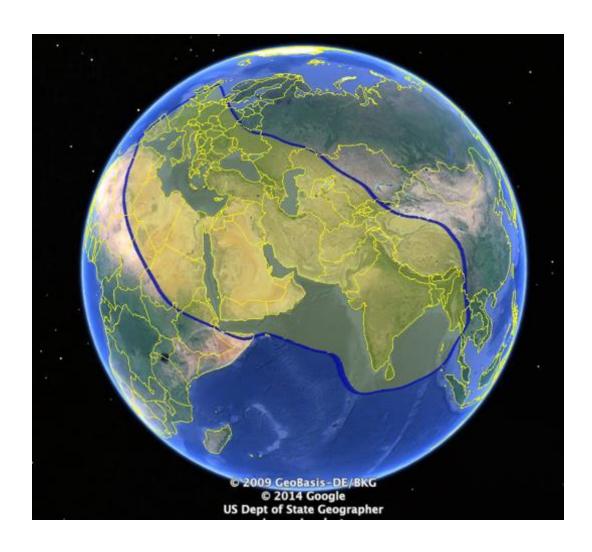
- litestream@erminal		Flitestream@erminal	
Site	Ankara	Site	Ankara
ntenna@vpe	HR6400	Antenna@vpe	HR6400
at	40.0 deg	Lat	39.6 deg
on	32.0 deg	Lon	31.3 deg
G/T	11.7 dB/K	EIRPEmax	45.0 dBW
atellite	11.7 UB/K	Satellite	43.0 dBW
	Eutelsat@W2A	Name	Eutelsat@W2A
lame			
ongitude	10.0 deg	Longitude	10.0 deg
lubŒarth'station		Hub@Earth@Station	
ite	Santander_7.2m	Site	Santander_7.2m
at	43.442 deg	Lat	43.442 deg
.on	-3.873 deg	Lon	-3.873 deg
IRPImax	80.0 dBW	G/T	35.6 dB/K
ignal		Signal	
Vaveform	DVB-S2	Waveform	iDirectRL-SF4
Modulation	QPSK	Modulation	BPSK
Bits@per@symbol	2	Bits@per@symbol	1
pread actor	1	Spread/Factor	4
CodingBate	0.67	Coding®ate	0.43
Overhead Rate	0.94	Overhead®ate	0.43
Channel Spacing	1.20	Channel Spacing	1.20
spectrall fficiency Rate/Noise WW)	1.25 bps/Hz	SpectrallEfficiency@Rate/NoiseBW)	0.07 bps/Hz
Data Rate	8.46E+06 bps	Data Rate	4.86E+05 bps
nformation (Rate (Data (Data)	9.00E+06 bps	Information Rate Data Dverhead)	7.18E+05 bps
Symbol Rate	6.75E+06 Hz	Symbol®Rate	1.67E+06 Hz
Chip (Rate (I) Noise (Bandwidth)	6.75E+06 Hz	Chip@Rate@Noise@Bandwidth)	6.66E+06 Hz
Occupied:Bandwidth	8.10E+06 Hz	Occupied:Bandwidth	8.00E+06 Hz
C/N@Threshold	3.5 dB	C/NIThreshold	-5.0 dB
Jplink		Uplink	
requency	13.762410 GHz	Frequency	14.153525 GHz
PowerIControlIMode	Automatic Uplink Power Control	Power@Control@Mode	Automatic@plink@ower@control
Back@off	9.1 dB	Backlibff	0.0 dB
IRPISpectral Density	38.6 dBW/4kHz	EIRPISpectral Density	12.8 dBW/4
Blant@Range	37939 km	SlantiRange	37845 km
space/Loss,/Ls	206.8 dB	SpaceILoss,ILs	207.0 dB
	0.0 dB		0.1 dB
Pointing Loss, Lpnt		Pointing Loss, Lpnt	
Atmosphere  Meather  Loss,  La	1.3 dB	Atmosphere	0.0 dB
Radome, 11 r	0.0 dB	Radome, 11 r	0.0 dB
Fransponder IG/T I@ IHub	1.0 dB/K	Transponder 16/T1@17 erminal	4.0 dB/K
Thermal@Noise,@C/No@	92.4 dBHz	Thermal@Noise,@C/No    Thermal@Noise,@C/No   Thermal@Noise,@C/No  Thermal@Noise,@C/No  Thermal@Noise,@C/No  Thermal@Noise,@C/No  Thermal@Noise,@C/No	70.5 dBHz
C/(No+Io)	91.9 dBHz	C/(No+lo)	70.3 dBHz
atellite		Satellite	
luxiDensity	-93.0 dBW/m2	FluxiDensity	-116.1 dBW/n
FD®@1Hub	-83.5 dBW/m2	SFD@@Terminal	-86.5 dBW/n
Small's ignal sain (IBO/OBO)	2.3 dB	Small@signal@Gain@IBO/OBO)	2.3 dB
ОВО	7.2 dB	ОВО	27.3 dB
Downlink®	7.2 00	Downlink®	27.3 UB
requency	11.462410 GHz	Frequency	12.562635 GHz
requency ransponder:5at.EIRPI@BeamIPeak	49.0 dBW	Transpondertsat.tEIRPt@tBeamtPeak	53.5 dBW
Fransponder®at.ŒIRP@@Terminal	46.0 dBW	Transponder®at.ŒIRP@@Hub	49.0 dBW
DLIPSDILimit	13.0 dBW/4kHz	DL®PSD@Limit	13.0 dBW/4
DLIPSDI@IBeamIPeak	9.6 dBW/4kHz	DLIPSDI@IBeamIPeak	-7.6 dBW/4
CarrierŒIRP@@Beam@Peak	41.8 dBW	CarrierŒIRP@@Beam@eak	24.6 dBW
CarrierŒIRP@@Terminal	38.8 dBW	CarrierŒIRP@@Hub	20.1 dBW
Slant@Range	37899 km	Slant Range	37939 km
paceILoss,ILs	205.2 dB	SpaceILoss,ILs	206.0 dB
ointingILoss,ILpnt	0.1 dB	Pointing@oss,@ont	0.0 dB
Atmosphere  Meather  Loss,  La	0.0 dB	Atmosphere@Weather@oss,@a	1.9 dB
Radome, II.r	0.0 dB	Radome, 11r	0.0 dB
PCMAILoss	0.0 dB	PCMAILoss	0.0 dB
Fhermal@Noise,@C/No	73.8 dBHz	Thermal®Noise,®C/No	76.4 dBHz
C/(No+lo)	73.7 dBHz	C/(No+lo)	76.4 dBHz
nditoEnd		End@oŒnd	
ndıtoı±ndıt(No+lo)	73.6 dBHz	End@oŒnd@C/(No+Io)	69.3 dBHz
mplementation Loss	1.0 dB	Implementation 11 oss	0.0 dB

### Forward Link Budge

Forward Link Budget		Return Link Budget			
eXConnect Terminal			eXConnect Terminal		
Antenna Type	HR129		Antenna Type	HR129	)
Lat	43.6	deg	Lat		deg
Lon	-0.7	-	Lon		deg deg
EIRP max		dBW	EIRP max		dBW
G/T		dB/K	G/T	11.1	dB/K
Satellite			Satellite		
Name	Eutelsat W2A		Name	Eutelsat W2A	١
Longitude	10.0	deg	Longitude	10.0	) deg
Hub Earth Station			Hub Earth Station		
Site	Cologne		Site	Cologne	
Lat	50.94	-	Lat	50.94	
Lon	6.96	-	Lon		deg
EIRP max		dBW	EIRP max		dBW
G/T	37.1	dB/K	G/T	37.1	. dB/K
Signal			Signal		
Waveform	DVB-S2		Waveform	iDirect	
Modulation	QPSK		Modulation	BPSk	
Bits per symbol	2		Bits per symbol	1	
Spread Factor	1		Spread Factor	2	
Coding Rate	0.50		Coding Rate	0.67	
Overhead Rate	0.83		Overhead Rate	0.72	
Channel Spacing	1.20		Channel Spacing	1.20	
Spectral Efficiency (Rate/Noise BW)		bps/Hz	Spectral Efficiency (Rate		bps/Hz
Data Rate Information Rate (Data + Overhead)	2.48E+07 3.00E+07	•	Data Rate	8.05E+05	
,		•	Information Rate (Data	· ·	
Symbol Rate	3.00E+07 3.00E+07		Symbol Rate	1.67E+06 vidth) 6.67E+06	
Chip Rate (Noise Bandwidth)	3.60E+07		Chip Rate (Noise Bandw	8.00E+06	
Occupied Bandwidth			Occupied Bandwidth		
Power Equivelent Bandwidth C/N Threshold	3.60E+07		Power Equivelent Band C/N Threshold		dB
Uplink	0.9	ав	Uplink	-4.2	: ub
Frequency	13.771	GH <sub>7</sub>	Frequency	14.125	GH <sub>7</sub>
Back off	6.2		Back off		d dB
EIRP Spectral Density		dBW/4kHz	EIRP Spectral Density		dBW/4kHz
Slant Range	38475		Slant Range	37895	
Space Loss, Ls	206.9		Space Loss, Ls	207.0	
Pointing Loss, Lpnt	0.0		Pointing Loss, Lpnt		dB ) dB
Atmosphere / Weather Loss, La	1.9		Atmosphere / Weather		dB
Radome, Lr	0.0		Radome, Lr		dB
Transponder G/T @ Hub		dB/K	Transponder G/T @ Ter		dB/K
Thermal Noise, C/No		dBHz	Thermal Noise, C/No		dBHz
C/(No+lo)		dBHz	C/(No+lo)		B dBHz
Satellite			Satellite		
Flux Density	-90.8	dBW/m2	Flux Density	-120.8	dBW/m2
SFD @ Hub		dBW/m2	SFD @ Terminal		dBW/m2
Small Signal Gain (IBO/OBO)	2.3		Small Signal Gain (IBO/0		dB
ОВО	1.0	dB	ово	33.0	) dB
Downlink			Downlink		
Frequency	11.471	GHz	Frequency	12.625	GHz
Transponder Sat. EIRP @ Beam Peak	49.0	dBW	Transponder Sat. EIRP @	@ Beam Peak 49.0	dBW
Transponder Sat. EIRP @ Terminal	48.0	dBW	Transponder Sat. EIRP @	@ Hub 48.0	dBW
DL PSD Limit	13.0	dBW/4kHz	DL PSD Limit		dBW/4kHz
DL PSD @ Beam Peak	9.2	dBW/4kHz	DL PSD @ Beam Peak	-16.3	dBW/4kHz
Carrier EIRP @ Beam Peak	48.0	dBW	Carrier EIRP @ Beam Pe	eak 16.0	dBW
Carrier EIRP @ Terminal		dBW	Carrier EIRP @ Hub		dBW
Slant Range	37895	km	Slant Range	38475	i km
Space Loss, Ls	205.2	dB	Space Loss, Ls	206.2	dB
Pointing Loss, Lpnt	0.0	dB	Pointing Loss, Lpnt	0.0	dB
Atmosphere / Weather Loss, La	0.0	dB	Atmosphere / Weather	Loss, La 3.0	dB
Radome, Lr	0.5	dB	Radome, Lr	0.0	dB
PCMA Loss	0.0	dB	PCMA Loss	0.0	dB
Thermal Noise, C/No	81.0	dBHz	Thermal Noise, C/No	71.5	dBHz
C/(No+lo)	76.7	dBHz	C/(No+lo)	67.3167	dBHz_
End to End			End to End		
End to End C/(No+lo)	76.7	dBHz	End to End C/(No+Io)	64.5	dBHz
Implementation Loss	1.0		Implementation Loss		) dB
End to End C/N w/ Imp Loss	0.9		End to End C/N w/ Imp		dB
Link Margin	0.0	dB	Link Margin	0.5	dB

# 6. EUTELSAT 70B

### Coverage Map



### **Satellite Operator Certification Letter**



June 9th, 2016

Federal Communications Commission International Bureau 445 12th Street, S.W. Washington, D.C. 20554

Re: Engineering Certification of Eutelsat

To Whom It May Concern:

This letter certifies that Eutelsat is aware that Astronics AeroSat Corporation ("Astronics AeroSat") is planning to seek authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAA") terminals with the Eutelsat 70B satellite at 70.5°E and the Eutelsat 10A satellite at 10°E. Eutelsat understands that Astronics AeroSat seeks to operate the previously authorized HR6400 Kuband antenna systems with these satellites for commercial purposes consistent with the FCC's ESAA rules, including Section 25.227.

Eutelsat confirms and hereby certifies the following with respect to the ESAA terminal operations proposed by Astronics AeroSat:

- a) The proposed Ku-band operation of Astronics AeroSat's ESAA terminal has the potential to create harmful interference to adjacent satellite networks that may be unacceptable;
- b) Eutelsat capacity on the Eutelsat 70B and Eutelsat 10A satellites is used for other ESAA operations;
- c) The proposed operation of the Astronics AeroSat terminals at the proposed power density levels is consistent with existing satellite coordination agreements with the satellites of the Eutelsat 70B and Eutelsat 10A satellites.

If the FCC authorizes the operation proposed by Astronics AeroSat, Eutelsat will include the power density levels specified by Astronics AeroSat, defined within the satellite coordination agreements, in all future satellite network coordination with operators of satellite that are adjacent to those satellites addressed by this letter.

Sincerely,

For Eutelsat

Filipe De Oliveira

Director of Resources Engineering

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June 9th, 2016

Federal Communications Commission International Bureau 445 12<sup>th</sup> Street, S.W. Washington, D.C. 20554

#### Re: Engineering Certification of Eutelsat

To Whom It May Concern:

This letter certifies that Eutelsat is aware that Astronics AeroSat Corporation ("Astronics AeroSat") is planning to seek authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAA") terminals with the Eutelsat 70B satellite at 70.5°E, Eutelsat 172A satellite at 172.0°E and the Eutelsat 10A satellite at 10°E. Eutelsat understands that Astronics AeroSat seeks to operate the previously authorized HR129 Ku-band antenna systems with these satellites for commercial purposes consistent with the FCC's ESAA rules, including Section 25.227.

Eutelsat confirms and hereby certifies the following with respect to the ESAA terminal operations proposed by Astronics AeroSat:

- The proposed Ku-band operation of Astronics AeroSat's ESAA terminal has the potential to create harmful interference to adjacent satellite networks that may be unacceptable;
- Eutelsat capacity on the Eutelsat 70B, Eutelsat 172A and Eutelsat 10A satellites is used for other ESAA operations;
- c) The proposed operation of the Astronics AeroSat terminals at the proposed power density levels is consistent with existing satellite coordination agreements with the satellites of the Eutelsat 70B, Eutelsat 172A and Eutelsat 10A satellites.

If the FCC authorizes the operation proposed by Astronics AeroSat, Eutelsat will include the power density levels specified by Astronics AeroSat, defined within the satellite coordination agreements, in all future satellite network coordination with operators of satellite that are adjacent to those satellites addressed by this letter.

Sincerely,

For Eutelsat Filipe De Oliveira

Director of Resources Engineering

### **Link Budgets**

#### Forward Link Budget

#### Flitestream@erminal Antenna⊡ype HR6400 31.4 deg Lon G/T 44.4 deg 10.3 dB/K Satellite Name Longitude HubŒarth®tation Site 70.5 deg Cyprus Lat 34.859 deg 33.384 deg 85.2 dBW Lon EIRPāmax G/T 37.4 dB/K Signal Waveform DVB-S2 Modulation Bits@ber@ymbol SpreadFactor CodingRate 0.67 Overhead Rate 0.94 Channel Spacing 1.20 Spectrall fficiency (Rate/Noise W) 1.26 bps/Hz 5.66E+07 bps Data@Rate Information Rate Data Dverhead) 6.00E+07 bps Symbol@Rate 4.50E+07 Hz Chip@Rate@Noise@Bandwidth) 4.50E+07 Hz Occupied Bandwidth 5.40E+07 Hz Power Equivelent Bandwidth C/N Threshold 5.40E+07 Hz 3.5 dB Uplink Frequency 13.125 GHz Back@ff EIRP®pectral@ensity 11.4 dB 33.3 dBW/4kHz Slant@Range Space@Loss,@Ls 38300 km 206.5 dB Pointing@Loss,@Lpnt 0.0 dB Atmosphere 2/2 Weather 1 oss, 1 a 1.9 dB Radome,**1**Lr 0.0 dB Transponder 6 / Ti@ Hub 3.8 dB/K 97.8 dBHz Thermal@Noise,@C/No@ C/(No+lo) 97.3 dBHz Satellite Flux@Density -90.8 dBW/m2 SFD@@Hub Small@signal@Gain@(IBO/OBO) -87.8 dBW/m2 2.0 dB OBO Downlink® 1.0 dB 11.325 GHz 50.0 dBW Transponder Sat. EIRP @ Beam Peak Transponder 55 at . 1 EIRP 1 @ 1 Terminal 49.0 dBW 13.0 dBW/4kHz DL@PSD@Limit DLIPSDI@BeamPeak CarrierIIRPI@BeamPeak 8.5 dBW/4kHz 49.0 dBW 48.0 dBW 37497 km Carrier IRP @ Terminal Slant@Range SpaceLoss,Ls PointingLoss,Lpnt 205.0 dB 0.1 dB Atmosphere@@Weather@Loss,@La Radome,@Lr 0.0 dB 0.0 dB PCMALoss 0.0 dB Thermal@Noise,@C/No 83.1 dBHz C/(No+Io) 83.0 dBHz End@to@End End@oŒnd@C/(No+Io) 82.8 dBHz Implementation ass 1.0 dB End@to@End@C/N@w/@Imp@Loss Link@Margin 1.8 dB

#### Return@Link@Budget

Flitestream@erminal		
AntennaType	HR6400	
Lat	31.4 de	eg
Lon	44.4 de	eg
EIRP@max	45.2 dl	ВW
Satellite		
Name	E70B	
Longitude	70.5 de	eg e
HubŒarth&tation		
Site	Cyprus	
Lat	34.859 de	
Lon	33.384 de	
G/T	37.4 dl	3/K
Signal		1
Waveform Modulation	iDirect BPSK	
	BP5K	
BitsIperIBymbol SpreadIFactor	1	
CodingRate	0.67	
Overhead® Rate	0.77	
Channel Spacing	1.20	
Spectrall fficiency Rate/Noise W)	0.51 b	ns/Hz
Data@Rate	2.57E+06 b	
InformationRate Data Dverhead)	3.34E+06 b	
Symbol Rate	5.00E+06 H	
Chip@ate@Noise@Bandwidth)	5.00E+06 H	
Occupied Bandwidth	6.00E+06 H	
C/NI hreshold	2.4 dl	
Uplink		
Frequency	14.500 G	Hz
Back@bff	0.0 dI	3
EIRP 5 pectral 10 ensity	14.2 dI	BW/4kHz
Slant®Range	37497 kr	m
Space@Loss,@Ls	207.2 dl	3
Pointing Loss, Lpnt	0.1 dl	3
Atmosphere  Atmosp	0.0 dl	3
Radome, ILr	0.0 dl	3
Transponder 16/Ti@ 17 erminal	3.8 dI	B/K
Thermal@Noise,@C/No@	70.3 dl	BHz
C/(No+lo)	70.0 dl	BHz
Satellite		
Flux@Density	-115.8 dl	
SFD@@Terminal	-92.8 dI	
Small®ignal@Gain@IBO/OBO)	1.9 di	
ОВО	21.1 dl	3
Downlink®		1
Frequency	12.625 G	
Transpondertsat. I IRP to Beam Peak	50.0 di	
Transpondersat. EIRP @ Hub	49.0 di	
DLIPSDILimit		BW/4kHz BW/4kHz
DLIPSDI@BeamIPeak CarrierIEIRPI@BeamIPeak	-3.7 di 27.3 di	
CarrierŒIRP@@Hub	27.3 di 26.1 di	
Slant@ange	26.1 di 38296 kr	
Space@Loss,@Ls	38296 Ki 206.1 di	
Pointing Loss, Lpnt	0.0 di	
Atmosphere Weather Loss, La	3.3 di	
Radome, Itr	0.0 dl	
PCMAtloss	0.0 di	
Thermal@Noise,@C/No	82.9 di	
C/(No+Io)	82.5 di	
End@toŒnd	52.5 di	
Endito End C/(No+lo)	69.7 dl	BHz
Implementation Loss	0.0 dl	
	2.7 di	
Implementation@coss End@cosend@c/N@w/@mp@coss Link@Margin		3

#### Forward Link Budget

#### eXConnect Terminal Antenna Type HR129 26.8 deg Lon EIRP max 42.2 dBW G/T 11.1 dB/K Satellite Name E70B Longitude 70.5 deg **Hub Earth Station** Site Cyprus 34.92 deg Lat Lon 33.64 deg EIRP max 77.8 dBW G/T 37.4 dB/K Signal Waveform DVB-S2 Modulation QPSK Bits per symbol 2 Spread Factor 1 Coding Rate 0.25 Overhead Rate 0.71 Channel Spacing 1.20 Spectral Efficiency (Rate/Noise BW) 0.35 bps/Hz 1.59E+07 bps Information Rate (Data + Overhead) 2.25E+07 bps Symbol Rate 4.50E+07 Hz Chip Rate (Noise Bandwidth) 4.50E+07 Hz Occupied Bandwidth 5.40E+07 Hz Power Equivelent Bandwidth 5.40E+07 Hz C/N Threshold -3.7 dB Uplink 13.156 GHz Frequency Back off 2.0 dB 35.4 dBW/4kHz EIRP Spectral Density 38287 km Slant Range Space Loss, Ls 206 5 dB Pointing Loss, Lpnt 0.0 dB Atmosphere / Weather Loss, La 2.0 dB 0.0 dB Radome, Lr Transponder G/T @ Hub 3.8 dB/K Thermal Noise, C/No 99.8 dBHz C/(No+lo) 99.3 dBHz Satellite Flux Density -88.8 dBW/m2 SFD @ Hub -85.8 dBW/m2 Small Signal Gain (IBO/OBO) 2.0 dB ОВО 1.0 dB Downlink Frequency 11.356 GHz Transponder Sat. EIRP @ Beam Peak 50.0 dBW Transponder Sat. EIRP @ Terminal 49.0 dBW DL PSD Limit 16.0 dBW/4kHz DL PSD @ Beam Peak 8.4 dBW/4kHz Carrier EIRP @ Beam Peak 49.0 dBW Carrier EIRP @ Terminal 48.0 dBW Slant Range 37005 km 204.9 dB Space Loss, Ls

0.0 dB

0.0 dB

0.5 dB

0.0 dB

82.2 dBHz

75.2 dBHz

75.2 dBHz

1.5 dB

-2.8 dB

0.9 dB

End to End C/N w/ Imp Loss

Link Margin

-4.0 dB

Pointing Loss, Lpnt

Thermal Noise, C/No

Implementation Loss

End to End C/N w/ Imp Loss

Radome, Lr

PCMA Loss

C/(No+lo)

End to End End to End C/(No+Io)

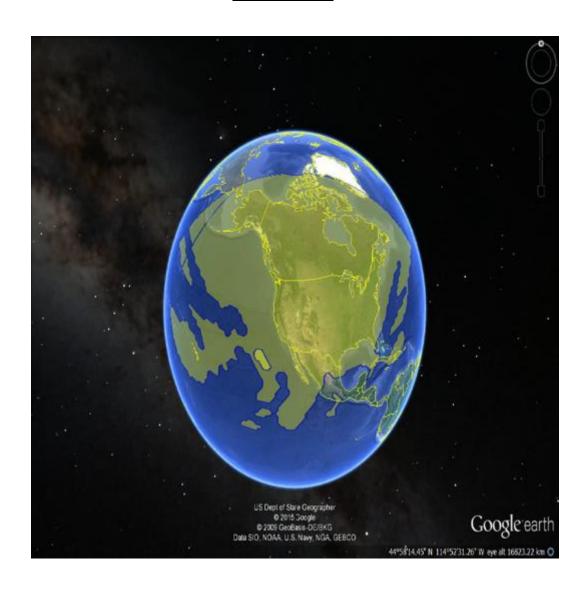
Link Margin

Atmosphere / Weather Loss, La

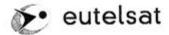
Return Link Bud <u>í</u>	get	
eXConnect Terminal		
Antenna Type Lat	HR129	
Lon	26.8 deg 91.0 deg	
EIRP max	42.2 dBW	
G/T	11.1 dB/K	
Satellite		
Name	E70B	
Longitude	70.5 deg	
Hub Earth Station		
Site	Cyprus	
Lat Lon	34.92 deg 33.64 deg	
EIRP max	77.8 dBW	
G/T	37.4 dB/K	
Signal	,	_
Waveform	iDirect	
Modulation	BPSK	
Bits per symbol	1	
Spread Factor	4	
Coding Rate	0.67	
Overhead Rate	0.72	
Channel Spacing	1.20	
Spectral Efficiency (Rate/Noise BW) Data Rate	0.12 bps/Hz 8.05E+05 bps	
Information Rate (Data + Overhead)	1.11E+06 bps	
Symbol Rate	1.67E+06 Hz	
Chip Rate (Noise Bandwidth)	6.67E+06 Hz	
Occupied Bandwidth	8.00E+06 Hz	
Power Equivelent Bandwidth	1.94E+05 Hz	
C/N Threshold	-4.2 dB	
Uplink		
Frequency	14.208 GHz	
Back off EIRP Spectral Density	0.4 dB 9.6 dBW/4k	ш-
Slant Range	37005 km	112
Space Loss, Ls	206.9 dB	
Pointing Loss, Lpnt	0.0 dB	
Atmosphere / Weather Loss, La	0.0 dB	
Radome, Lr	0.5 dB	
Transponder G/T @ Terminal	2.8 dB/K	
Thermal Noise, C/No	65.8 dBHz	
C/(No+lo)	65.3 dBHz	
Satellite	124.4 IDW/	_
Flux Density SFD @ Terminal	-121.1 dBW/m -89.8 dBW/m	
Small Signal Gain (IBO/OBO)	-83.8 dBW/III	2
OBO	29.4 dB	
Downlink		_
Frequency	12.708 GHz	
Transponder Sat. EIRP @ Beam Peak	50.0 dBW	
Transponder Sat. EIRP @ Hub	49.0 dBW	
DL PSD Limit	16.0 dBW/4k	
DL PSD @ Beam Peak	-11.7 dBW/4k	Hz
Carrier EIRP @ Beam Peak	20.6 dBW	
Carrier EIRP @ Hub	19.6 dBW	
Slant Range Space Loss, Ls	38287 km 206.2 dB	
Pointing Loss, Lpnt	0.0 dB	
Atmosphere / Weather Loss, La	3.9 dB	
Radome, Lr	0.0 dB	
PCMA Loss	0.0 dB	
Thermal Noise, C/No	75.4 dBHz	
C/(No+Io)	70.7825 dBHz	
End to End		
End to End C/(No+lo)	64.2 dBHz	Ī
Implementation Loss	0.0 dB	

# 7. EUTELSAT 115WB

### Coverage Map



### **Satellite Operator Certification Letter**



September 6, 2016

Federal Communications Commission International Bureau 445 12<sup>th</sup> Street, S.W. Washington, D.C. 20554

Re: Engineering Certification of Eutelsat Americas (HR6400 on E115WB)

To Whom It May Concern:

This letter certifies that Eutelsat Americas ("EAS") is aware that Astronics AeroSat Corporation ("Astronics AeroSat") is planning to seek authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAA") terminals with the Eutelsat 115WB (E115WB) satellite located at 114.9° W.L. Specifically, we understand that Astronics AeroSat seeks to operate the previously authorized HR6400 Ku-band antenna system with E115WB for commercial purposes consistent with the FCC's ESAA rules, including Section 25.227.

Based on the information provided by Astronics AeroSat, EAS understands the technical characteristics of the HR6400 terminal, and EAS (i) recognizes that operation of the HR6400 terminals at the power density levels provided to EAS is consistent with existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from E115WB; (ii) acknowledges that the proposed operation of the HR6400 terminal has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable; (iii) if the operation of this antenna should cause unacceptable interference towards adjacent satellite networks, Astronics AeroSat agrees to cease transmissions immediately upon notice from EAS; and (iv) if the FCC authorizes the operations proposed by Astronics AeroSat, EAS will take into consideration the power density levels associated with such operations in future satellite network coordinations with adjacent satellite operators.

Sincerely,

Hector Fortis Eutelsat Americas

International and Regulatory Affairs

18



September 6, 2016

Federal Communications Commission International Bureau 445 12<sup>th</sup> Street, S.W. Washington, D.C. 20554

> Re: Engineering Certification of Eutelsat Americas (HR129 on E115WB and E117WA)

To Whom It May Concern:

This letter certifies that Eutelsat Americas ("EAS") is aware that Astronics AeroSat Corporation ("Astronics AeroSat") is planning to seek authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAA") terminals with the Eutelsat 115WB (E115WB) satellite located at 114.9° W.L and the Eutelsat 117WA (E117WA) satellite located at 116.8° W.L. Specifically, we understand that Astronics AeroSat seeks to operate the HR129 Ku-band antenna system with E115WB and E117WA for commercial purposes consistent with the FCC's ESAA rules, including Section 25.227.

Based on the information provided by Astronics AeroSat, EAS understands the technical characteristics of the HR129 terminal, and EAS (i) recognizes that operation of the HR129 terminals at the power density levels provided to EAS is consistent with existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from E115WB and E117WA; (ii) acknowledges that the proposed operation of the HR6400 terminal has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable; (iii) if the operation of this antenna should cause unacceptable interference towards adjacent satellite networks, Astronics AeroSat agrees to cease transmissions immediately upon notice from EAS; and (iv) if the FCC authorizes the operations proposed by Astronics AeroSat, EAS will take into consideration the power density levels associated with such operations in future satellite network coordinations with adjacent satellite operators.

Sincerely,

Hector Fortis Eutelsat Americas

International and Regulatory Affairs

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### **Link Budgets**

#### Forward Link Budget

### Return Link Budget (Link 1)

Flitestream Terminal			Flitestream Terminal	
Site			Site	
Antenna Type	HR6400		Antenna Type	HR6400
Lat	45.0	deg	Lat	45.0 deg
Lon	-80.0		Lon	-80.0 deg
G/T	12.1	dB/K	EIRP max	45.1 dBW
Satellite			Satellite	
Name	E 115WB		Name	E 115WB
Longitude	-114.9	deg	Longitude	-114.9 deg
Hub Earth Station			Hub Earth Station	
Site	Brewster		Site	Brewster
Lat	48.1		Lat	48.1 deg
Lon	-119.8		Lon	-119.8 deg
EIRP max	80.1	dBW	G/T	33.4 dB/K
Signal	D1 (D. CO.		Signal	181 .
Waveform	DVB-S2		Waveform	iDirect
Modulation	8PSK 3		Modulation	QPSK 2
Bits per symbol	3		Bits per symbol	-
Spread Factor	1		Spread Factor	1
Coding Rate Overhead Rate	0.75 0.92		Coding Rate Overhead Rate	0.50 0.83
Channel Spacing	1.20		Channel Spacing	1.20
		/! I=		
Spectral Efficiency (Rate/Noise BW Data Rate	6.22E+07 l	ops/Hz	Spectral Efficiency (Rate/Noise BV Data Rate	0.83 bps/Hz 5.53E+06 bps
Information Rate (Data + Overhead				
Symbol Rate	3.00E+07 I		Information Rate (Data + Overhead Symbol Rate	6.67E+06 bps 6.67E+06 Hz
Chip Rate (Noise Bandwidth)	3.00E+07 I		Chip Rate (Noise Bandwidth)	6.67E+06 Hz
	3.60E+07 I			8.00E+06 Hz
Occupied Bandwidth C/N Threshold			Occupied Bandwidth C/N Threshold	
Uplink	8.5 (	JB .	Uplink	3.6 dB
Frequency	14.327000 (	CH-	Frequency	14.327000 GHz
	Automatic Uplink	-	T T	utomatic Uplink Power Control
Back off	3.8 c		Back off	0.0 dB
EIRP Spectral Density		dBW/4kHz	EIRP Spectral Density	12.9 dBW/4kHz
Slant Range	38218		Slant Range	38813 km
Space Loss, Ls	207.2		Space Loss, Ls	207.3 dB
Pointing Loss, Lpnt	0.0		Pointing Loss, Lpnt	0.1 dB
Atmosphere / Weather Loss, La	1.4		Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0		Radome, Lr	0.0 dB
Transponder G/T @ Hub	2.0		Transponder G/T @ Terminal	6.0 dB/K
Thermal Noise, C/No	98.3		Thermal Noise, C/No	72.2 dBHz
C/(No+lo)	93.3		C/(No+lo)	72.0 dBHz
Satellite	93.3 (	10112	Satellite	72.0 db112
Flux Density	-877	dBW/m2	Flux Density	-116.9 dBW/m2
SFD @ Hub		dBW/m2	SFD @ Terminal	-100.0 dBW/m2
Small Signal Gain (IBO/OBO)	2.0		Small Signal Gain (IBO/OBO)	1.5 dB
OBO	1.7		OBO	15.4 dB
Downlink	2., ,		Downlink	1511 05
Frequency	12.027000	GHz	Frequency	12.027 GHz
Transponder Sat. EIRP @ Beam Per	53.5 (	dBW	Transponder Sat. EIRP @ Beam Pe	53.5 dBW
Transponder Sat. EIRP @ Terminal			Transponder Sat. EIRP @ Hub	49.0 dBW
DL PSD Limit		dBW/4kHz	DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	13.0	dBW/4kHz	DL PSD @ Beam Peak	5.0 dBW/4kHz
Carrier EIRP @ Beam Peak	51.8	dBW	Carrier EIRP @ Beam Peak	37.2 dBW
Carrier EIRP @ Terminal	51.3		Carrier EIRP @ Hub	32.7 dBW
Slant Range	38813 I		Slant Range	38218 km
Space Loss, Ls			Space Loss, Ls	205.7 dB
	205.8			
Pointing Loss, Lpnt	0.1	dB .	Pointing Loss, Lpnt	0.0 dB
Pointing Loss, Lpnt Atmosphere / Weather Loss, La			Pointing Loss, Lpnt Atmosphere / Weather Loss, La	0.0 dB 1.6 dB
	0.1	dВ		
Atmosphere / Weather Loss, La	0.1 0	dB dB	Atmosphere / Weather Loss, La	1.6 dB
Atmosphere / Weather Loss, La Radome, Lr	0.1 c 0.0 c	dB dB dB	Atmosphere / Weather Loss, La Radome, Lr	1.6 dB 0.0 dB
Atmosphere / Weather Loss, La Radome, Lr PCMA Loss	0.1 c 0.0 c 0.0 c	dB dB dB dB dBHz	Atmosphere / Weather Loss, La Radome, Lr PCMA Loss	1.6 dB 0.0 dB 0.0 dB
Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No	0.1 c 0.0 c 0.0 c 86.0 c	dB dB dB dB dBHz	Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No	1.6 dB 0.0 dB 0.0 dB 87.4 dBHz
Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo)	0.1 c 0.0 c 0.0 c 86.0 c	dB dB dB dBHz dBHz	Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo)	1.6 dB 0.0 dB 0.0 dB 87.4 dBHz
Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo) End to End	0.1 c 0.0 c 0.0 c 0.0 c 86.0 c 85.6 c	dB dB dB dBHz dBHz	Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+lo) End to End	1.6 dB 0.0 dB 0.0 dB 87.4 dBHz 86.7 dBHz
Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+Io) End to End End to End C/(No+Io)	0.1 ( 0.0 ( 0.0 ( 0.0 ( 86.0 ( 85.6 (	BB BB BBHz BBHz BBHz	Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+Io) End to End End to End	1.6 dB 0.0 dB 0.0 dB 87.4 dBHz 86.7 dBHz
Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+Io) End to End End to End C/(No+Io) Implementation Loss	0.1 ( 0.0 ( 0.0 ( 0.0 ( 86.0 ( 85.6 ( 84.9 ( 1.0 (	dB dB dB dBHz dBHz dBHz dBHz	Atmosphere / Weather Loss, La Radome, Lr PCMA Loss Thermal Noise, C/No C/(No+Io) End to End End to End C/(No+Io) Implementation Loss	1.6 dB 0.0 dB 0.0 dB 87.4 dBHz 86.7 dBHz 71.8 dBHz 0.0 dB

Forward Link Budget		Return Link Budget		
eXConnect Terminal		eXConnect Terminal		
Antenna Type	HR129	Antenna Type	HR129	
Lat	51.9 deg	Lat	51.9 deg	
Lon	-96.2 deg	Lon	-96.2 deg	
EIRP max	42.0 dBW	EIRP max	42.0 dBW	
G/T	11.4 dB/K	G/T	11.4 dB/K	
Satellite Name	SatMex-7	Satellite Name	SatMex-7	
Longitude	-114.9 deg	Longitude	-114.9 deg	
Hub Earth Station	22.10 000	Hub Earth Station	==	
Site	Brewster	Site	Brewster	
.at	48.147 deg	Lat	48.147 deg	
.on	-119.691 deg	Lon	-119.691 deg	
EIRP max	80.0 dBW	EIRP max	80.0 dBW	
G/T	32.4 dB/K	G/T	32.4 dB/K	
Signal		Signal		
Waveform	DVB-S2	Waveform	iDirect	
Modulation	QPSK	Modulation	BPSK	
Bits per symbol	2	Bits per symbol	1	
Spread Factor	1	Spread Factor	1	
Coding Rate	0.50	Coding Rate	0.50	
Overhead Rate	0.83	Overhead Rate	0.74	
hannel Spacing	1.20	Channel Spacing	1.20	
Spectral Efficiency (Rate/Noise BW)	0.83 bps/Hz	Spectral Efficiency (Rate/Noise BW)	0.37 bps/Hz	
Data Rate	2.48E+07 bps	Data Rate	2.45E+06 bps	
nformation Rate (Data + Overhead)	3.00E+07 bps	Information Rate (Data + Overhead)	3.34E+06 bps	
ymbol Rate	3.00E+07 Hz	Symbol Rate	6.67E+06 Hz	
hip Rate (Noise Bandwidth)	3.00E+07 Hz	Chip Rate (Noise Bandwidth)	6.67E+06 Hz	
Occupied Bandwidth	3.60E+07 Hz	Occupied Bandwidth	8.00E+06 Hz	
Power Equivelent Bandwidth	3.60E+07 Hz	Power Equivelent Bandwidth	2.26E+06 Hz	
/N Threshold	0.9 dB	C/N Threshold	0.5 dB	
Jplink		Uplink		
requency Back off	14.380 GHz	Frequency	14.350 GHz	
	10.1 dB	Back off	0.8 dB	
IRP Spectral Density	31.1 dBW/4kHz 38225 km	EIRP Spectral Density	9.0 dBW/4kl 38787 km	
lant Range	207.3 dB	Slant Range	207.4 dB	
pace Loss, Ls ointing Loss, Lpnt	0.0 dB	Space Loss, Ls Pointing Loss, Lpnt	0.0 dB	
Atmosphere / Weather Loss, La	1.5 dB	Atmosphere / Weather Loss, La	0.0 dB	
Radome, Lr	0.0 dB	Radome, Lr	0.5 dB	
ransponder G/T @ Hub	6.0 dB/K	Transponder G/T @ Terminal	8.0 dB/K	
Fhermal Noise, C/No	95.8 dBHz	Thermal Noise, C/No	69.9 dBHz	
C/(No+lo)	95.3 dBHz	C/(No+lo)	69.4 dBHz	
Satellite	55.5 dbHz	Satellite	05.4 05112	
lux Density	-94.2 dBW/m2	Flux Density	-122.1 dBW/m2	
FD @ Hub	-91.2 dBW/m2	SFD @ Terminal	-102.4 dBW/m2	
imall Signal Gain (IBO/OBO)	2.0 dB	Small Signal Gain (IBO/OBO)	3.0 dB	
DBO	1.0 dB	OBO	16.8 dB	
Downlink		Downlink		
requency	12.080 GHz	Frequency	12.050 GHz	
ransponder Sat. EIRP @ Beam Peak	53.5 dBW	Transponder Sat. EIRP @ Beam Peak	53.5 dBW	
ransponder Sat. EIRP @ Terminal	53.0 dBW	Transponder Sat. EIRP @ Hub	52.0 dBW	
DL PSD Limit	14.2 dBW/4kHz	DL PSD Limit	14.2 dBW/4k	
DL PSD @ Beam Peak	13.7 dBW/4kHz	DL PSD @ Beam Peak	4.5 dBW/4k	
Carrier EIRP @ Beam Peak	52.5 dBW	Carrier EIRP @ Beam Peak	36.7 dBW	
Carrier EIRP @ Terminal	52.0 dBW	Carrier EIRP @ Hub	35.2 dBW	
lant Range	38787 km	Slant Range	38225 km	
pace Loss, Ls	205.9 dB	Space Loss, Ls	205.7 dB	
ointing Loss, Lpnt	0.0 dB	Pointing Loss, Lpnt	0.0 dB	
tmosphere / Weather Loss, La	0.0 dB	Atmosphere / Weather Loss, La	2.0 dB	
ladome, Lr	0.5 dB	Radome, Lr	0.0 dB	
PCMA Loss	0.0 dB	PCMA Loss	0.0 dB	
hermal Noise, C/No	85.6 dBHz	Thermal Noise, C/No	88.5 dBHz	
C/(No+lo)	77.3 dBHz	C/(No+lo)	82.2263 dBHz	
ind to End		End to End		
End to End C/(No+lo)	77.2 dBHz	End to End C/(No+Io)	69.2 dBHz	
mplementation Loss	1.0 dB	Implementation Loss	0.0 dB	
•	1.5 dB	End to End C/N w/ Imp Loss	0.9 dB	
End to End C/N w/ Imp Loss				

### 8. EUTELSAT 117WA

### Coverage Map



### **Satellite Operator Certification Letter**



September 6, 2016

Federal Communications Commission International Bureau 445 12<sup>th</sup> Street, S.W. Washington, D.C. 20554

> Re: Engineering Certification of Eutelsat Americas (HR129 on E115WB and E117WA)

To Whom It May Concern:

This letter certifies that Eutelsat Americas ("EAS") is aware that Astronics AeroSat Corporation ("Astronics AeroSat") is planning to seek authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAA") terminals with the Eutelsat 115WB (E115WB) satellite located at 114.9° W.L and the Eutelsat 117WA (E117WA) satellite located at 116.8° W.L. Specifically, we understand that Astronics AeroSat seeks to operate the HR129 Ku-band antenna system with E115WB and E117WA for commercial purposes consistent with the FCC's ESAA rules, including Section 25.227.

Based on the information provided by Astronics AeroSat, EAS understands the technical characteristics of the HR129 terminal, and EAS (i) recognizes that operation of the HR129 terminals at the power density levels provided to EAS is consistent with existing coordination agreements with all adjacent satellite operators within +/- 6 degrees of orbital separation from E115WB and E117WA; (ii) acknowledges that the proposed operation of the HR6400 terminal has the potential to receive harmful interference from adjacent satellite networks that may be unacceptable; (iii) if the operation of this antenna should cause unacceptable interference towards adjacent satellite networks, Astronics AeroSat agrees to cease transmissions immediately upon notice from EAS; and (iv) if the FCC authorizes the operations proposed by Astronics AeroSat, EAS will take into consideration the power density levels associated with such operations in future satellite network coordinations with adjacent satellite operators.

Sincerely,

Hector Fortis Eutelsat Americas

International and Regulatory Affairs

Je de

### **Link Budget**

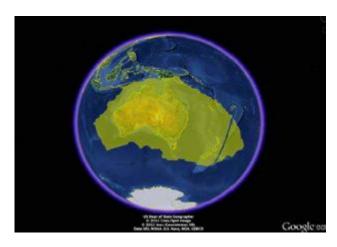
Return Link Budget

### Forward Link Budget

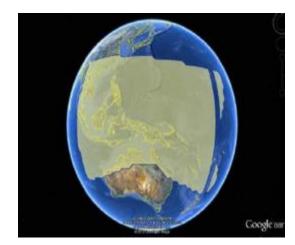
eXConnect Terminal		eXConnect Terminal	
Antenna Type	HR129	Antenna Type	HR129
Lat	28.9 deg	Lat	28.9 deg
Lon	-82.2 deg	Lon	-82.2 deg
EIRP max	41.9 dBW	EIRP max	41.9 dBW
G/T	11.3 dB/K	G/T	11.3 dB/K
Satellite		Satellite	
Name	STM8	Name	STM8
Longitude	-116.8 deg	Longitude	-116.8 deg
Hub Earth Station		Hub Earth Station	
Site	Brewster	Site	Brewster
Lat	48.1 deg	Lat	48.1 deg
Lon	-119.8 deg	Lon	-119.8 deg
EIRP max	80.0 dBW	EIRP max	80.0 dBW
G/T Signal	37.3 dB/K	G/T Signal	37.3 dB/K
Signal Waveform	DVB-S2	Signal Waveform	iDirect
Modulation	QPSK	Modulation	BPSK
Bits per symbol	2	Bits per symbol	1
Spread Factor	1	Spread Factor	8
Coding Rate	0.50	Coding Rate	0.67
Overhead Rate	0.83	Overhead Rate	0.72
Channel Spacing	1.20	Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.83 bps/Hz	Spectral Efficiency (Rate/Noise BW)	0.06 bps/Hz
Data Rate	2.48E+07 bps	Data Rate	4.03E+05 bps
Information Rate (Data + Overhead)	3.00E+07 bps	Information Rate (Data + Overhead)	5.56E+05 bps
Symbol Rate	3.00E+07 Hz	Symbol Rate	8.34E+05 Hz
Chip Rate (Noise Bandwidth)	3.00E+07 Hz	Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	3.60E+07 Hz	Occupied Bandwidth	8.00E+06 Hz
Power Equivelent Bandwidth	3.60E+07 Hz	Power Equivelent Bandwidth	5.71E+04 Hz
C/N Threshold	0.9 dB	C/N Threshold	-7.2 dB
Uplink		Uplink	
Frequency	14.260 GHz	Frequency	14.300 GHz
Back off	2.6 dB	Back off	3.0 dB
EIRP Spectral Density	38.6 dBW/4kHz	EIRP Spectral Density	6.7 dBW/4kHz
Slant Range	38211 km	Slant Range	37837 km
Space Loss, Ls	207.2 dB	Space Loss, Ls	207.1 dB
Pointing Loss, Lpnt	0.0 dB	Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	1.4 dB	Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB	Radome, Lr	0.5 dB
Transponder G/T @ Hub	2.0 dB/K	Transponder G/T @ Terminal	5.0 dB/K
Thermal Noise, C/No	99.5 dBHz	Thermal Noise, C/No	64.9 dBHz
C/(No+lo) Satellite	99.0 dBHz	C/(No+lo) Satellite	64.4 dBHz
Flux Density	-86.6 dBW/m2	Flux Density	-124.2 dBW/m2
SFD @ Hub	-84.3 dBW/m2	SFD @ Terminal	-91.2 dBW/m2
Small Signal Gain (IBO/OBO)	1.3 dB	Small Signal Gain (IBO/OBO)	1.3 dB
OBO	1.0 dB	OBO	31.7 dB
Downlink	2.0 40	Downlink	J2.7 4D
Frequency	11.960 GHz	Frequency	12.000 GHz
Transponder Sat. EIRP @ Beam Peak	51.7 dBW	Transponder Sat. EIRP @ Beam Peak	51.7 dBW
Transponder Sat. EIRP @ Terminal	50.9 dBW	Transponder Sat. EIRP @ Hub	48.9 dBW
DL PSD Limit	14.5 dBW/4kHz	DL PSD Limit	14.5 dBW/4kHz
DL PSD @ Beam Peak	11.9 dBW/4kHz	DL PSD @ Beam Peak	-12.3 dBW/4kHz
Carrier EIRP @ Beam Peak	50.7 dBW	Carrier EIRP @ Beam Peak	20.0 dBW
Carrier EIRP @ Terminal	49.9 dBW	Carrier EIRP @ Hub	17.2 dBW
Slant Range	37837 km	Slant Range	38211 km
Space Loss, Ls	205.6 dB	Space Loss, Ls	205.7 dB
Pointing Loss, Lpnt	0.0 dB	Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB	Atmosphere / Weather Loss, La	1.7 dB
Destaura Lu	0.5 dB	Radome, Lr	0.0 dB
Radome, Lr			
PCMA Loss	0.0 dB	PCMA Loss	0.0 dB
	0.0 dB 83.8 dBHz	PCMA Loss Thermal Noise, C/No	75.7 dBHz
PCMA Loss Thermal Noise, C/No C/(No+lo)	0.0 dB	Thermal Noise, C/No C/(No+lo)	
PCMA Loss Thermal Noise, C/No C/(No+Io) End to End	0.0 dB 83.8 dBHz 77.0 dBHz	Thermal Noise, C/No C/(No+lo) End to End	75.7 dBHz 66.8776 dBHz
PCMA Loss Thermal Noise, C/No C/(No+lo) End to End End to End C/(No+lo)	0.0 dB 83.8 dBHz 77.0 dBHz 76.9 dBHz	Thermal Noise, C/No C/(No+lo) End to End End to End C/(No+lo)	75.7 dBHz 66.8776 dBHz 62.5 dBHz
PCMA Loss Thermal Noise, C/No C/(No+lo) End to End End to End C/(No+lo) Implementation Loss	0.0 dB 83.8 dBHz 77.0 dBHz 76.9 dBHz 1.0 dB	Thermal Noise, C/No C/(No+lo) End to End End to End C/(No+lo) Implementation Loss	75.7 dBHz 66.8776 dBHz 62.5 dBHz 0.0 dB
PCMA Loss Thermal Noise, C/No C/(No+lo) End to End End to End C/(No+lo)	0.0 dB 83.8 dBHz 77.0 dBHz 76.9 dBHz	Thermal Noise, C/No C/(No+lo) End to End End to End C/(No+lo)	75.7 dBHz 66.8776 dBHz 62.5 dBHz

# 9. EUTELSAT 172A

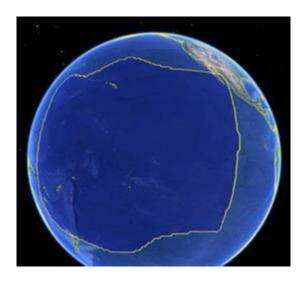
### Coverage Map



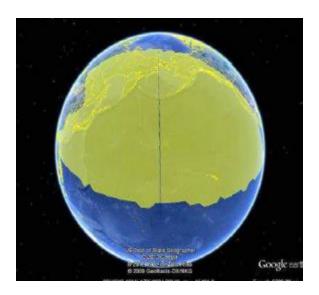
**South Pacific** 



**Southwest Pacific** 



**Southeast Pacific** 



**North Pacific** 

### **Satellite Operator Certification Letter**



June 9th, 2016

Federal Communications Commission International Bureau 445 12<sup>th</sup> Street, S.W. Washington, D.C. 20554

Re: Engineering Certification of Eutelsat

To Whom It May Concern:

This letter certifies that Eutelsat is aware that Astronics AeroSat Corporation ("Astronics AeroSat") is planning to seek authorization from the Federal Communications Commission ("FCC") to operate Ku-band transmit/receive earth stations aboard aircraft ("ESAA") terminals with the Eutelsat 70B satellite at 70.5°E, Eutelsat 172A satellite at 172.0°E and the Eutelsat 10A satellite at 10°E. Eutelsat understands that Astronics AeroSat seeks to operate the previously authorized HR129 Ku-band antenna systems with these satellites for commercial purposes consistent with the FCC's ESAA rules, including Section 25.227.

Eutelsat confirms and hereby certifies the following with respect to the ESAA terminal operations proposed by Astronics AeroSat:

- The proposed Ku-band operation of Astronics AeroSat's ESAA terminal has the potential to create harmful interference to adjacent satellite networks that may be unacceptable;
- Eutelsat capacity on the Eutelsat 70B, Eutelsat 172A and Eutelsat 10A satellites is used for other ESAA operations;
- c) The proposed operation of the Astronics AeroSat terminals at the proposed power density levels is consistent with existing satellite coordination agreements with the satellites of the Eutelsat 70B, Eutelsat 172A and Eutelsat 10A satellites.

If the FCC authorizes the operation proposed by Astronics AeroSat, Eutelsat will include the power density levels specified by Astronics AeroSat, defined within the satellite coordination agreements, in all future satellite network coordination with operators of satellite that are adjacent to those satellites addressed by this letter.

Sincerely,

For Euteleat Filipe De Oliveira

Director of Resources Engineering

### **Link Budget**

#### Forward Link Budget

## ## ## ## ## ## ## ## ## ## ## ## ##	Forward Link Budget		Return Link Budget		
Antenna Type	eXConnect Terminal		eXConnect Terminal		
Lon		HR129		HR129	
	Lat	4.9 deg	Lat	4.9 deg	
SATE	Lon	114.8 deg	Lon	114.8 deg	
Satellite	EIRP max	42.0 dBW	EIRP max	42.0 dBW	
Name		11.0 dB/K	L.	11.0 dB/K	
No.   Ste					
Site		172.0 deg		172.0 deg	
Lat		Bt		D	
Lon					
Signal   S		-		-	
Signal   S		-		-	
Signal					
Waveform   DVB-S2   Modulation   OPSK   Bits per symbol   2   Spread Factor   1   1   Coding Rate   0.67   Overheed Rate   0.67   Overheed Rate   0.57   Overheed Rate   0.57   Overheed Rate   0.57   Overheed Rate   0.59   Overheed Rate   0.57   Overheed Rate   0.55   Overh		33.0 db/K		33.0 db/ k	
Modulation         OPSK         Modulation         BPSK           Bils per symbol         2         2           Spread Factor         0.67         6           Overhead Bate         0.94         Coding Bate         0.67           Overhead Bate         0.94         Coding Bate         0.72           Channel Spacing         1.20         Channel Spacing         1.20           Spectral Efficiency (Rate/Noise BW)         1.26 bps/hz         Data Rate         0.06 bps/hz           Data Rate         7.37 bcf6 btp         Data Rate         4.02E-45 bps           Information Rate (Data + Overhead)         1.03E-66 btp         Data Rate         4.02E-45 bps           Information Rate (Data + Overhead)         1.03E-66 btp         Data Rate         4.02E-45 bps           Information Rate (Data + Overhead)         1.03E-66 btp         Data Rate         4.02E-45 bps           Symbol Rate         7.73E-66 btp         Chip Rate (Noise Bandwidth)         7.95E-66 btp           Occupied Bandwidth         7.93E-66 btp         Chip Rate (Noise Bandwidth)         7.95E-66 btp           Ocwpread plander Bandwidth         1.94E-67 btp         Chip Rate (Noise Bandwidth)         7.95E-66 btp           Opewer Equivelent Bandwidth         1.94E-67 btp         Chip Rate (Noise Bandwidth)		DVB-S2		iDirect	
Bits per symbol   2					
Spread Factor					
Coding Rate	7 7				
Overhead Rate         0.94           Channel Spacing         1.20           Spectral Efficiency (Rate/Noise BW)         1.26 bps/Hz           Data Rate         9.72E+06 bps           Information Rate (Data + Overhead)         1.08E+07 bps           Information Rate (Data + Overhead)         1.08E+07 bps           Information Rate (Data + Overhead)         1.08E+07 bps           Information Rate (Data + Overhead)         5.55E+05 bps           Symbol Rate         7.73E+06 Hz           Occupied Bandwidth         9.28E+06 Hz           Power Equivelent Bandwidth         1.94E+07 Hz           C/N Threshold         3.5 dB           Uplink         1.09Ink           Frequency         14.363 GHz           Back off         6.5 dB           EIRP Spectral Density         40.7 dBW/4kHz           Slant Range         40558 km           Space Loss, Ls         20.73 dB           Pointing Loss, Lpnt         0.0 dB           Radome, Lr         0.0 dB           Transponder Off @ Hub         1.0 dB/K           Transponder Scale (F)         9.6 d BW/a           Sro @ Hus         8.5 dBHz           Sto @ Hus         8.5 dBWz           Small Signal Gain (IBO/OBO)         1.9 dB </td <td>  T</td> <td>0.67</td> <td></td> <td>0.67</td>	T	0.67		0.67	
Spectral Efficiency (Rate/Noise BW)	=	0.94	=	0.72	
Data Rate   9.72E-06 bps   Information Rate (Data + Overhead)   1.03E-07 bps   Information Rate (Data + Overhead)   1.03E-07 bps   Information Rate (Data + Overhead)   5.55E-05 bps   Symbol Rate   7.73E+06 Hz	Channel Spacing	1.20	Channel Spacing	1.20	
Information Rate (Data + Overhead)   1.03E+07   bps   Symbol Rate (Noise Bandwidth)   7.73E+06   Hz   Chip Rate (Noise Bandwidth)   7.73E+06   Hz   Chip Rate (Noise Bandwidth)   6.66E+06   Hz   Occupied Bandwidth   9.28E+06   Hz   Occupied Bandwidth   1.9E+07   Hz   Chip Rate (Noise Bandwidth)   2.60E+05   Hz   Chip Rate (Noise Bandwidth)	Spectral Efficiency (Rate/Noise BW)	1.26 bps/Hz	Spectral Efficiency (Rate/Noise BW)	0.06 bps/Hz	
Symbol Rate   7.73E+06 Hz   Chip Rate (Noise Bandwidth)   7.73E+06 Hz   Chip Rate (Noise Bandwidth)   7.73E+06 Hz   Chip Rate (Noise Bandwidth)   6.66E+06 Hz   Chip Rate (Noise Bandwidth)   7.79E+06 Hz   Chip Rate (Noise Bandwidth)   7.79E+	Data Rate	9.72E+06 bps	Data Rate	4.02E+05 bps	
Chip Rate (Noise Bandwidth)	Information Rate (Data + Overhead)	1.03E+07 bps	Information Rate (Data + Overhead)	5.55E+05 bps	
Occupied Bandwidth         9.28E+06 Hz         Power Equivelent Bandwidth         7.99E+06 Hz           Power Equivelent Bandwidth         1.94E+07 Hz         Power Equivelent Bandwidth         2.50E+05 Hz           C/N Threshold         3.5 dB         Uplink         -7.2 dB           Frequency         14.363 GHz         Back off         6.5 dB           Back off         6.5 dB         ERP Spectral Density         9.8 dBW/4kHz           Slant Range         40558 km         Back off         0.0 dB           Space Loss, Ls         207.8 dB         Space Loss, Ls         207.3 dB           Pointing Loss, Lpnt         0.0 dB         Radome, Lr         0.0 dB           Radome, Lr         0.0 dB         Radome, Lr         0.0 dB           Transponder G/T @ Hub         1.0 dB/K         Transponder G/T @ Terminal         2.0 dB/K           Thermal Noise, C/No         88.6 dBHz         Transponder G/T @ Terminal         2.0 dB/K           The Lix Density         -96.4 dBW/m2         Satellite         Flux Density         -96.4 dBW/m2           SFD @ Hub         -89.0 dBW/m2         Small Signal Gain (IBO/OBO)         1.9 dB         Small Signal Gain (IBO/OBO)         1.9 dB           Downlink         -7requency         11.563 GHz         Transponder Sat. EIRP @ Beam Pe	Symbol Rate	7.73E+06 Hz	Symbol Rate	8.33E+05 Hz	
Power Equivelent Bandwidth	Chip Rate (Noise Bandwidth)		Chip Rate (Noise Bandwidth)	6.66E+06 Hz	
C/N Threshold   3.5 dB   Uplink   Frequency	T T T T T T T T T T T T T T T T T T T				
Uplink   Frequency			5		
Frequency		3.5 dB		-7.2 dB	
Back off         6.5 dB         Back off         0.0 dB           EIRP Spectral Density         40.7 dBW/kHz         EIRP Spectral Density         9.8 dBW/kHz           Share Range         40858 km         Slant Range         39096 km           Space Loss, Ls         207.8 dB         Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         6.8 dB         Atmosphere / Weather Loss, La         0.0 dB           Radome, Lr         1.0 dB/K         Transponder G/T @ Hub         1.0 dB/K           Thermal Noise, C/No         88.6 dBHz         Transponder G/T @ Terminal         2.0 dB/K           C/(No-lo)         88.1 dBHz         Transponder G/T @ Terminal         2.0 dB/K           Statellite         Thermal Noise, C/No         64.7 dBHz           SFD @ Hub         -89.0 dBW/m2         SFD @ Terminal         91.0 dBW/m2           SFD @ Hub         -89.0 dBW/m2         SFD @ Terminal         91.0 dBW/m2           SFD @ Hub         -89.0 dBW/m2         SFD @ Terminal         91.0 dBW/m2           SFD @ Hub         -89.0 dBW/m2         SFD @ Terminal         91.0 dBW/m2           SFD @ Hub         -89.0 dBW/m2         SFD @ Terminal         91.0 dBW/m2           SFD @ Hub         -80.0 dBW/m2         SFD @ Terminal         9					
EIRP Spectral Density					
Slant Range					
Space Loss, Ls         207.8 dB         Space Loss, Ls         207.3 dB           Pointing Loss, Lpnt         0.0 dB         Atmosphere / Weather Loss, La         6.8 dB         Atmosphere / Weather Loss, La         0.0 dB           Radome, Lr         0.0 dB         Radome, Lr         0.5 dB         Transponder G/T @ Hub         1.0 dB/K         Transponder G/T @ Terminal         2.0 dB/K           Thermal Noise, C/No         88.6 dBHz         C/(No-Ho)         64.2 dBHz         C/(No-Ho)         64.2 dBHz           Stellite         Flux Density         -96.4 dBW/m2         SFD @ Hub         SSPD @ Terminal         SSPD @ Terminal         -91.0 dBW/m2           SMall Signal Gain (IBO/OBO)         1.9 dB         OBO         28.5 dB	The state of the s	· ·		·	
Pointing Loss, Lpnt	=		=		
Atmosphere / Weather Loss, La         6.8 dB         Atmosphere / Weather Loss, La         0.0 dB         Radome, Lr         0.0 dB         0.0 dB         Radome, Lr         0.5 dB         0.5 dB         Radome, Lr         0.5 dB         0.5 dB         No.5 dB         0.0 dB/K         Transponder G/T @ Terminal         2.0 dB/K         Thermal Noise, C/No         64.7 dBHz         GB/L         C/(No+lo)         64.2 dBHz         CSC         Stellite         Thermal Noise, C/No         64.7 dBHz         C/(No+lo)         64.2 dBHz         CSC         Stellite         Thermal Noise, C/No         64.7 dBHz         C/(No+lo)         64.2 dBHz         CSC         Stellite         Thermal Noise, C/No         64.7 dBHz         C/(No+lo)         64.2 dBHz         CSC         CSC         CY(No+lo)         64.2 dBHz         CSC         CY(No+lo)         64.2 dBHz         CSC         CSC <td></td> <td></td> <td></td> <td></td>					
Radome, Lr         0.0 dB         Radome, Lr         0.5 dB           Transponder G/T @ Hub         1.0 dB/K         Transponder G/T @ Terminal         2.0 dB/K           Left Morel         88.6 dBHz         Transponder G/T @ Terminal         2.0 dB/K           C/(No+lo)         88.1 dBHz         C/(No+lo)         64.2 dBHz           Satellite         Satellite           FIUX Density         -96.4 dBW/m2         SFD @ Terminal         -91.0 dBW/m2           SFD @ Hub         -89.0 dBW/m2         SFD @ Terminal         -91.0 dBW/m2           Small Signal Gain (IBO/OBO)         1.9 dB         OBO         28.5 dB           OBO         5.5 dB         OBO         28.5 dB           Downlink         Downlink           Frequency         11.563 GHz         Transponder Sat. EIRP @ Beam Peak         47.4 dBW           Transponder Sat. EIRP @ Beam Peak         47.4 dBW         Transponder Sat. EIRP @ Beam Peak         46.0 dBW           DL PSD Limit         9.0 dBW/4kHz         DL PSD Limit         9.0 dBW/4kHz           DL PSD @ Beam Peak         41.9 dBW         Carrier EIRP @ Beam Peak         -14.7 dBW           Carrier EIRP @ Beam Peak         41.5 dBW         Carrier EIRP @ Beam Peak         17.5 dBW					
Transponder G/T @ Hub         1.0 dB/K           Thermal Noise, C/No         88.6 dBHz           C/(No+lo)         88.1 dBHz           Satellite           Flux Density         -96.4 dBM/m2           SFD @ Hub         -89.0 dBW/m2           SFD @ Hub         -89.0 dBW/m2           SFD @ Hub         -89.0 dBW/m2           SFD @ Terminal         91.0 dBW/m2           SBD Oso         5.5 dB           Downlink         5mall Signal Gain (IBO/OBO)         1.9 dB           Frequency         11.563 GHz         5mall Signal Gain (IBO/OBO)         1.9 dB           Transponder Sat. EIRP @ Beam Peak         47.4 dBW         Transponder Sat. EIRP @ Beam Peak         46.0 dBW           Transponder Sat. EIRP @ Terminal         47.0 dBW         Transponder Sat. EIRP @ Beam Peak         46.0 dBW           DL PSD Limit         9.0 dBW/4kHz         DL PSD Limit         9.0 dBW/4kHz           OL PSD Limit         9.0 dBW/4kHz         DL PSD Dimit         9.0 dBW/4kHz           Carrier EIRP @ Beam Peak         41.5 dBW         Carrier EIRP @ Beam Peak         14.7 dBW/4kHz           Shart Range         39096 km         Space Loss, Ls         205.6 dB           Space Loss, Ls         205.6 dB         Space Loss, Ls					
Thermal Noise, C/No					
C/(No+lo)         88.1 dBHz           Satellite         Satellite           Flux Density         -96.4 dBW/m2           SFP @ Hub         -89.0 dBW/m2           Small Signal Gain (IBO/OBO)         1.9 dB           OBO         5.5 dB           Downlink           Frequency         11.563 GHz           Transponder Sat. EIRP @ Beam Peak         47.4 dBW           Transponder Sat. EIRP @ Terminal         47.0 dBW           DL PSD Limit         9.0 dBW/4kHz           DL PSD Limit         9.0 dBW/4kHz           Carrier EIRP @ Beam Peak         41.9 dBW           Carrier EIRP @ Beam Peak         41.5 dBW           Carrier EIRP @ Terminal         41.5 dBW           Slant Range         39096 km           Space Loss, Ls         205.6 dB           Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB           Radome, Lr         0.5 dB           PCMA Loss         0.0 dB           PCMA Loss	1	· ·		•	
Satellite         Satellite           Flux Density         -96.4 dBW/m2         Flux Density         -121.4 dBW/m2           SFD @ Hub         -89.0 dBW/m2         SFD @ Terminal         -91.0 dBW/m2           Small Signal Gain (IBO/OBO)         1.9 dB         OBO         28.5 dB           Downlink         Downlink         Downlink         Downlink         Transponder Sat. EIRP @ Beam Peak         47.4 dBW           Transponder Sat. EIRP @ Beam Peak         47.4 dBW         Transponder Sat. EIRP @ Beam Peak         46.0 dBW           Transponder Sat. EIRP @ Terminal         47.0 dBW         Transponder Sat. EIRP @ Beam Peak         46.0 dBW           DL PSD Limit         9.0 dBW/4kHz         DL PSD Limit         9.0 dBW/4kHz           DL PSD @ Beam Peak         41.9 dBW         Carrier EIRP @ Beam Peak         -14.7 dBW/4kHz           DL PSD @ Beam Peak         41.5 dBW         DL PSD Limit         9.0 dBW/4kHz           DL PSD @ Beam Peak         17.5 dBW         Slant Range         80 dBW/4kHz           Carrier EIRP @ Terminal         41.5 dBW         Slant Range         40858 km           Space Loss, Ls         205.6 dB         Space Loss, Ls         205.6 dB           Pointing Loss, Lpnt         0.0 dB         Atmosphere / Weather Loss, La         6.6 dB					
SFD @ Hub         -89.0 dBW/m2         SFD @ Terminal         -91.0 dBW/m2           Small Signal Gain (IBO/OBO)         1.9 dB         5.5 dB         0BO         28.5 dB         28.5 dB         0BO         28.5 dB         28.5 dB         0BO         0BO         28.5 dB         28.5 dB         28.5 dB         0BO         28.5 dB         28.5 dB         28.5 dB         0BO         28.5 dB         28.5 dB         28.5 dB         28.5 dB         29.5 dBW         72.0 dBW         72.0 dBW/4kHz         29.5 dBW/4kHz         29.5 dBW/4kHz         29.5 dBW         24.5 dBW         <					
Small Signal Gain (IBO/OBO)         1.9 dB         OBO         28.5 dB           Downlink           Downlink           Frequency         11.563 GHz         Downlink           Transponder Sat. EIRP @ Beam Peak         47.4 dBW         Transponder Sat. EIRP @ Beam Peak         46.0 dBW           DL PSD Limit         9.0 dBW/4kHz         DL PSD Limit         9.0 dBW/4kHz           DL PSD Limit         9.0 dBW/4kHz         DL PSD Beam Peak         46.0 dBW           Carrier EIRP @ Beam Peak         41.9 dBW         DL PSD Beam Peak         -14.7 dBW/4kHz           Carrier EIRP @ Terminal         41.5 dBW         Carrier EIRP @ Beam Peak         17.5 dBW           Slant Range         39096 km         Slant Range         4858 km           Space Loss, Ls         205.6 dB         Space Loss, Ls         205.6 dB           Pointing Loss, Lpnt         0.0 dB         Atmosphere / Weather Loss, La         6.6 dB           Radome, Lr         0.5 dB         Radome, Lr         0.0 dB           PCMA Loss         0.0 dB         PCMA Loss         0.0 dB           PCMA Loss         0.0 dB         Thermal Noise, C/No         68.9 dBHz           C/(No+lo)         73.4 dBHz         Thermal Noise, C/No         67.4161 dBHz <t< td=""><td>Flux Density</td><td>-96.4 dBW/m2</td><td>Flux Density</td><td>-121.4 dBW/m2</td></t<>	Flux Density	-96.4 dBW/m2	Flux Density	-121.4 dBW/m2	
OBO	SFD @ Hub	-89.0 dBW/m2	SFD @ Terminal	-91.0 dBW/m2	
Downlink         Downlink           Frequency         11.563 GHz           Transponder Sat. EIRP @ Beam Peak         47.4 dBW           Transponder Sat. EIRP @ Terminal         47.0 dBW           DL PSD Limit         9.0 dBW/4kHz           DL PSD @ Beam Peak         9.0 dBW/4kHz           DL PSD @ Beam Peak         9.0 dBW/4kHz           Carrier EIRP @ Beam Peak         41.9 dBW           Carrier EIRP @ Terminal         41.5 dBW           Slant Range         39096 km           Space Loss, Ls         205.6 dB           Space Loss, Ls         205.6 dB           Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB           Radome, Lr         0.5 dB           PCMA Loss         0.0 dB           Thermal Noise, C/No         75.0 dBHz           C/(No+lo)         73.6 dBHz           End to End         Thermal Noise, C/No           End to End C/(No+lo)         73.4 dBHz           Implementation Loss         1.0 dB           End to End C/N w/ Imp Loss         3.5 dB	Small Signal Gain (IBO/OBO)	1.9 dB	Small Signal Gain (IBO/OBO)	1.9 dB	
Frequency	ОВО	5.5 dB	ОВО	28.5 dB	
Transponder Sat. EIRP @ Beam Peak         47.4 dBW         Transponder Sat. EIRP @ Beam Peak         46.0 dBW           Transponder Sat. EIRP @ Terminal         47.0 dBW         Transponder Sat. EIRP @ Hub         46.0 dBW           DL PSD Limit         9.0 dBW/4kHz         DL PSD Limit         9.0 dBW/4kHz           DL PSD Beam Peak         9.0 dBW/4kHz         DL PSD Beam Peak         -14.7 dBW/4kHz           Carrier EIRP @ Beam Peak         41.9 dBW         Carrier EIRP @ Beam Peak         17.5 dBW           Carrier EIRP @ Terminal         41.5 dBW         Carrier EIRP @ Hub         17.5 dBW           Slant Range         39096 km         Slant Range         40858 km           Space Loss, Ls         205.6 dB         Space Loss, Ls         205.6 dB           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB         Atmosphere / Weather Loss, La         6.6 dB           Radome, Lr         0.0 dB         Radome, Lr         0.0 dB           PCMA Loss         0.0 dB         Thermal Noise, C/No         68.9 dBHz           C/(No+lo)         73.6 dBHz         Thermal Noise, C/No         67.4161 dBHz           End to End         End to End C/(No+lo)         62.5 dBHz           Implementation Los	Downlink		Downlink		
Transponder Sat. EIRP @ Terminal         47.0 dBW         Transponder Sat. EIRP @ Hub         46.0 dBW           DL PSD Limit         9.0 dBW/4kHz         DL PSD Limit         9.0 dBW/4kHz           DL PSD @ Beam Peak         9.0 dBW/4kHz         DL PSD limit         9.0 dBW/4kHz           Carrier EIRP @ Beam Peak         41.9 dBW         17.5 dBW           Carrier EIRP @ Terminal         41.5 dBW         Carrier EIRP @ Beam Peak         17.5 dBW           Slant Range         39096 km         Slant Range         40858 km           Space Loss, Ls         205.6 dB         Space Loss, Ls         205.6 dB           Pointing Loss, Lpnt         0.0 dB         Atmosphere / Weather Loss, La         6.6 dB           Radome, Lr         0.5 dB         Radome, Lr         0.0 dB           PCMA Loss         0.0 dB         PCMA Loss         0.0 dB           PCMA Loss         0.0 dB         PCMA Loss         0.0 dB           PCMA Los         Thermal Noise, C/No         68.9 dBHz         67.4161 dBHz           End to End         End to End C/(No+lo)         67.4161 dBHz         67.4161 dBHz           End to End C/(No+lo)         73.4 dBHz         Implementation Loss         0.0 dB         Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss					
DL PSD Limit         9.0 dBW/4kHz         DL PSD Limit         9.0 dBW/4kHz           DL PSD @ Beam Peak         9.0 dBW/4kHz         DL PSD @ Beam Peak         -14.7 dBW/4kHz           Carrier EIRP @ Beam Peak         41.9 dBW         Carrier EIRP @ Beam Peak         17.5 dBW           Carrier EIRP @ Terminal         41.5 dBW         Carrier EIRP @ Hub         17.5 dBW           Slant Range         39096 km         Slant Range         40858 km           Space Loss, Ls         205.6 dB         Space Loss, Ls         205.6 dB           Pointing Loss, Lpnt         0.0 dB         Atmosphere / Weather Loss, La         6.6 dB           Radome, Lr         0.5 dB         Radome, Lr         0.0 dB           PCMA Loss         0.0 dB         PCMA Loss         0.0 dB           Thermal Noise, C/No         75.0 dBHz         Thermal Noise, C/No         68.9 dBHz           C/(No+lo)         73.6 dBHz         C/(No+lo)         67.4161 dBHz           End to End         End to End         End to End         End to End C/(No+lo)         62.5 dBHz           Implementation Loss         1.0 dB         End to End C/(No+lo)         62.5 dBHz					
DL PSD @ Beam Peak         9.0 dBW/4kHz         DL PSD @ Beam Peak         -14.7 dBW/4kHz           Carrier EIRP @ Beam Peak         41.9 dBW         Carrier EIRP @ Beam Peak         17.5 dBW           Carrier EIRP @ Terminal         41.5 dBW         Carrier EIRP @ Beam Peak         17.5 dBW           Slant Range         39096 km         Slant Range         40858 km           Space Loss, Ls         205.6 dB         Space Loss, Ls         205.6 dB           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB         Atmosphere / Weather Loss, La         6.6 dB           Radome, Lr         0.0 dB         Radome, Lr         0.0 dB           PCMA Loss         0.0 dB         PCMA Loss         0.0 dB           Thermal Noise, C/No         75.0 dBHz         Thermal Noise, C/No         68.9 dBHz           C/(No+lo)         73.6 dBHz         C/(No+lo)         67.4161 dBHz           End to End         End to End C/(No+lo)         62.5 dBHz           Implementation Loss         1.0 dB         Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss         3.5 dB         End to End C/N w/ Imp Loss         -5.7 dB					
Carrier EIRP @ Beam Peak         41.9 dBW         Carrier EIRP @ Beam Peak         17.5 dBW           Carrier EIRP @ Terminal         41.5 dBW         Carrier EIRP @ Hub         17.5 dBW           Slant Range         39096 km         Slant Range         40858 km           Space Loss, Ls         205.6 dB         Space Loss, Ls         205.6 dB           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB         Atmosphere / Weather Loss, La         6.6 dB           Radome, Lr         0.0 dB         Radome, Lr         0.0 dB           PCMA Loss         0.0 dB         Thermal Noise, C/No         68.9 dBHz           C/(No+lo)         73.6 dBHz         C/(No+lo)         67.4161 dBHz           End to End C/(No+lo)         73.4 dBHz         End to End C/(No+lo)         62.5 dBHz           Implementation Loss         1.0 dB         Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss         3.5 dB         End to End C/N w/ Imp Loss         -5.7 dB				'	
Carrier EIRP @ Terminal         41.5 dBW         Carrier EIRP @ Hub         17.5 dBW           Slant Range         39096 km         Slant Range         40858 km           Space Loss, Ls         205.6 dB         Space Loss, Ls         205.6 dB           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB         Atmosphere / Weather Loss, La         6.6 dB           Radome, Lr         0.0 dB         Radome, Lr         0.0 dB           PCMA Loss         0.0 dB         Thermal Noise, C/No         68.9 dBHz           C/(No+lo)         73.6 dBHz         Thermal Noise, C/No         67.4161 dBHz           End to End         End to End C/(No+lo)         67.4161 dBHz           Implementation Loss         1.0 dB         Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss         3.5 dB         End to End C/N w/ Imp Loss         -5.7 dB	_	'			
Slant Range         39096 km         Slant Range         40858 km           Space Loss, Ls         205.6 dB         Space Loss, Ls         205.6 dB           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB         Atmosphere / Weather Loss, La         6.6 dB           Radome, Lr         0.5 dB         Radome, Lr         0.0 dB           PCMA Loss         0.0 dB         PCMA Loss         0.0 dB           Thermal Noise, C/No         75.0 dBHz         Thermal Noise, C/No         68.9 dBHz           C/(No+lo)         73.6 dBHz         C/(No+lo)         67.4161 dBHz           End to End C/(No+lo)         73.4 dBHz         End to End C/(No+lo)         62.5 dBHz           Implementation Loss         1.0 dB         Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss         3.5 dB         End to End C/N w/ Imp Loss         -5.7 dB					
Space Loss, Ls         205.6 dB         Space Loss, Ls         205.6 dB           Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB         Atmosphere / Weather Loss, La         6.6 dB           Radome, Lr         0.0 dB         Radome, Lr         0.0 dB           PCMA Loss         0.0 dB         PCMA Loss         0.0 dB           Thermal Noise, C/No         75.0 dBHz         Thermal Noise, C/No         68.9 dBHz           C/(No+lo)         73.6 dBHz         C/(No+lo)         67.4161 dBHz           End to End         End to End C/(No+lo)         62.5 dBHz           Implementation Loss         1.0 dB         Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss         3.5 dB         End to End C/N w/ Imp Loss         -5.7 dB					
Pointing Loss, Lpnt         0.0 dB         Pointing Loss, Lpnt         0.0 dB           Atmosphere / Weather Loss, La         0.0 dB         Atmosphere / Weather Loss, La         6.6 dB           Radome, Lr         0.0 dB         Radome, Lr         0.0 dB           PCMA Loss         0.0 dB         PCMA Loss         0.0 dB           Thermal Noise, C/No         75.0 dBHz         Thermal Noise, C/No         68.9 dBHz           C/(No+lo)         73.6 dBHz         C/(No+lo)         67.4161 dBHz           End to End C         End to End C/(No+lo)         62.5 dBHz           Implementation Loss         1.0 dB         Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss         3.5 dB         End to End C/N w/ Imp Loss         -5.7 dB	=		_		
Atmosphere / Weather Loss, La     0.0 dB     Atmosphere / Weather Loss, La     6.6 dB       Radome, Lr     0.0 dB     Radome, Lr     0.0 dB       PCMA Loss     0.0 dB     PCMA Loss     0.0 dB       Thermal Noise, C/No     75.0 dBHz     Thermal Noise, C/No     68.9 dBHz       C/(No+lo)     73.6 dBHz     C/(No+lo)     67.4161 dBHz       End to End C     End to End C/(No+lo)     62.5 dBHz       Implementation Loss     1.0 dB     Implementation Loss     0.0 dB       End to End C/N w/ Imp Loss     3.5 dB     End to End C/N w/ Imp Loss     -5.7 dB					
Radome, Lr         0.5 dB         Radome, Lr         0.0 dB           PCMA Loss         0.0 dB         PCMA Loss         0.0 dB           Thermal Noise, C/No         75.0 dBHz         Thermal Noise, C/No         68.9 dBHz           C/(No+lo)         73.6 dBHz         C/(No+lo)         67.4161 dBHz           End to End C/(No+lo)         73.4 dBHz         End to End C/(No+lo)         62.5 dBHz           Implementation Loss         1.0 dB         Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss         3.5 dB         End to End C/N w/ Imp Loss         -5.7 dB					
PCMA Loss         0.0 dB         PCMA Loss         0.0 dB           Thermal Noise, C/No         75.0 dBHz         Thermal Noise, C/No         68.9 dBHz           C/(No+lo)         73.6 dBHz         C/(No+lo)         67.4161 dBHz           End to End C/(No+lo)         73.4 dBHz         End to End C/(No+lo)         62.5 dBHz           Implementation Loss         1.0 dB         Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss         3.5 dB         End to End C/N w/ Imp Loss         -5.7 dB					
Thermal Noise, C/No         75.0 dBHz         Thermal Noise, C/No         68.9 dBHz           C/(No+lo)         73.6 dBHz         C/(No+lo)         67.4161 dBHz           End to End         End to End C/(No+lo)         67.4 dBHz           Ind to End C/(No+lo)         73.4 dBHz         End to End C/(No+lo)         62.5 dBHz           Implementation Loss         0.0 dB         Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss         3.5 dB         End to End C/N w/ Imp Loss         -5.7 dB					
C/(No+lo)         73.6 dBHz         C/(No+lo)         67.4161 dBHz           End to End         End to End C End to End         End to End C End to End to End C End to End C End to End to End to End C End to					
End to End         End to End           End to End C/(No+lo)         73.4 dBHz         End to End C/(No+lo)         62.5 dBHz           Implementation Loss         1.0 dB         Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss         3.5 dB         End to End C/N w/ Imp Loss         -5.7 dB					
End to End C/(No+Io)         73.4 dBHz         End to End C/(No+Io)         62.5 dBHz           Implementation Loss         1.0 dB         Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss         3.5 dB         End to End C/N w/ Imp Loss         -5.7 dB		75.0 00112		07.7101 UDIIZ	
Implementation Loss         1.0 dB         Implementation Loss         0.0 dB           End to End C/N w/ Imp Loss         3.5 dB         End to End C/N w/ Imp Loss         -5.7 dB		73.4 dBHz		62.5 dBHz	
End to End C/N w/ Imp Loss 3.5 dB End to End C/N w/ Imp Loss -5.7 dB					
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	Link Margin		Link Margin	1.5 dB	

#### Forward Link Budget

### Return Link Budget

eXConnect Terminal		eXConnect Terminal	
Antenna Type	HR129	Antenna Type	HR129
Lat	-27.0 deg	Lat	-27.0 deg
Lon	153.8 deg	Lon	153.8 deg
EIRP max	41.9 dBW	EIRP max	41.9 dBW
G/T	11.3 dB/K	G/T	11.3 dB/K
Satellite		Satellite	
Name	GE-23	Name	GE-23
Longitude	172.0 deg	Longitude	172.0 deg
Hub Earth Station		<b>Hub Earth Station</b>	
Site	Adelaide	Site	Adelaide
Lat	-35 deg	Lat	-35 deg
Lon	138 deg	Lon	138 deg
EIRP max	80.0 dBW	EIRP max	80.0 dBW
G/T	34.0 dB/K	G/T	34.0 dB/K
Signal		Signal	
Waveform	DVB-S2	Waveform	iDirect
Modulation	8PSK	Modulation	BPSK
Bits per symbol	3	Bits per symbol	1
Spread Factor	1	Spread Factor	2
Coding Rate	0.60	Coding Rate	0.67
Overhead Rate	0.94	Overhead Rate	0.72
Channel Spacing	1.20	Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.69 bps/Hz	Spectral Efficiency (Rate/Noise BW)	0.24 bps/Hz
Data Rate	3.35E+07 bps	Data Rate	1.61E+06 bps
Information Rate (Data + Overhead)	3.57E+07 bps	Information Rate (Data + Overhead)	2.22E+06 bps
Symbol Rate	1.98E+07 Hz	Symbol Rate	3.34E+06 Hz
Chip Rate (Noise Bandwidth)	1.98E+07 Hz	Chip Rate (Noise Bandwidth)	6.67E+06 Hz
Occupied Bandwidth	2.38E+07 Hz	Occupied Bandwidth	8.00E+06 Hz
Power Equivelent Bandwidth	3.60E+07 Hz	Power Equivelent Bandwidth	5.11E+05 Hz
C/N Threshold	6.3 dB	C/N Threshold	-1.2 dB
Uplink		Uplink	
Frequency	14.319 GHz	Frequency	14.319 GHz
Back off	14.7 dB	Back off	0.0 dB
EIRP Spectral Density	28.4 dBW/4kHz	EIRP Spectral Density	9.7 dBW/4kHz
Slant Range	38125 km	Slant Range	36931 km
Space Loss, Ls	207.2 dB	Space Loss, Ls	206.9 dB
Pointing Loss, Lpnt	0.0 dB	Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	2.2 dB	Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB	Radome, Lr	0.5 dB
Transponder G/T @ Hub	3.0 dB/K	Transponder G/T @ Terminal	6.0 dB/K
Thermal Noise, C/No	87.5 dBHz	Thermal Noise, C/No	69.0 dBHz
C/(No+lo)	87.0 dBHz	C/(No+lo)	68.5 dBHz
Satellite		Satellite	
Flux Density	-99.5 dBW/m2	Flux Density	-121.0 dBW/m2
SFD @ Hub	-93.5 dBW/m2	SFD @ Terminal	-96.5 dBW/m2
Small Signal Gain (IBO/OBO)	1.9 dB	Small Signal Gain (IBO/OBO)	1.9 dB
ОВО	4.1 dB	ОВО	22.6 dB
Downlink		Downlink	
Frequency	12.571 GHz	Frequency	12.571 GHz
Transponder Sat. EIRP @ Beam Peak	53.2 dBW	Transponder Sat. EIRP @ Beam Peak	53.2 dBW
Transponder Sat. EIRP @ Terminal	53.0 dBW	Transponder Sat. EIRP @ Hub	53.0 dBW
DL PSD Limit	13.0 dBW/4kHz	DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	12.1 dBW/4kHz	DL PSD @ Beam Peak	-1.6 dBW/4kHz
Carrier EIRP @ Beam Peak	49.1 dBW	Carrier EIRP @ Beam Peak	30.6 dBW
Carrier EIRP @ Terminal	48.9 dBW	Carrier EIRP @ Hub	30.4 dBW
Slant Range	36931 km	Slant Range	38125 km
Space Loss, Ls	205.8 dB	Space Loss, Ls	206.1 dB
Pointing Loss, Lpnt	0.0 dB	Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB	Atmosphere / Weather Loss, La	2.8 dB
Radome, Lr	0.5 dB	Radome, Lr	0.0 dB
PCMA Loss	0.0 dB	PCMA Loss	0.0 dB
Thermal Noise, C/No	82.5 dBHz	Thermal Noise, C/No	84.1 dBHz
C/(No+lo)	81.6 dBHz	C/(No+lo)	76.2118 dBHz
End to End		End to End	
End to End C/(No+lo)	80.5 dBHz	End to End C/(No+Io)	67.9 dBHz
Implementation Loss	1.0 dB	Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	6.5 dB	End to End C/N w/ Imp Loss	-0.4 dB
Link Margin	0.2 dB	Link Margin	0.8 dB

#### Forward Link Budget

### Return Link Budget

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eXConnect Terminal		eXConnect Terminal	
Antenna Type	HR129	Antenna Type	HR129
Lat	-0.2 deg	Lat	-0.2 deg
Lon	-140.2 deg	Lon	-140.2 deg
EIRP max	41.7 dBW	EIRP max	41.7 dBW
G/T Satellite	11.1 dB/K	G/T Satellite	11.1 dB/K
Name	GE-23	Name	GE-23
Longitude	172.0 deg	Longitude	172.0 deg
Hub Earth Station	172.0 deg	Hub Earth Station	172.0 deg
Site	Brewster	Site	Brewster
Lat	47 deg	Lat	47 deg
Lon	-122 deg	Lon	-122 deg
EIRP max	80.0 dBW	EIRP max	80.0 dBW
G/T	35.0 dB/K	G/T	35.0 dB/K
Signal	33.0 45/1	Signal	33.0 db/10
Waveform	DVB-S2	Waveform	iDirect
Modulation	QPSK	Modulation	BPSK
Bits per symbol	2	Bits per symbol	1
Spread Factor	1	Spread Factor	8
Coding Rate	0.50	Coding Rate	0.67
Overhead Rate	0.83	Overhead Rate	0.72
Channel Spacing	1.20	Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	0.83 bps/Hz	Spectral Efficiency (Rate/Noise BW)	0.06 bps/Hz
Data Rate	3.62E+06 bps	Data Rate	4.02E+05 bps
Information Rate (Data + Overhead)	4.38E+06 bps	Information Rate (Data + Overhead)	5.55E+05 bps
Symbol Rate	4.38E+06 Hz	Symbol Rate	8.33E+05 Hz
Chip Rate (Noise Bandwidth)	4.38E+06 Hz	Chip Rate (Noise Bandwidth)	6.66E+06 Hz
Occupied Bandwidth	5.25E+06 Hz	Occupied Bandwidth	7.99E+06 Hz
Power Equivelent Bandwidth	8.90E+06 Hz	Power Equivelent Bandwidth	1.78E+05 Hz
C/N Threshold	0.9 dB	C/N Threshold	-7.2 dB
Uplink		Uplink	
Frequency	14.453 GHz	Frequency	14.199 GHz
Back off	9.4 dB	Back off	0.0 dB
EIRP Spectral Density	40.2 dBW/4kHz	EIRP Spectral Density	9.5 dBW/4kHz
Slant Range	40858 km	Slant Range	38178 km
Space Loss, Ls	207.9 dB	Space Loss, Ls	207.1 dB
Pointing Loss, Lpnt	0.0 dB	Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	6.8 dB	Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.0 dB	Radome, Lr	0.5 dB
Transponder G/T @ Hub	1.0 dB/K	Transponder G/T @ Terminal	1.0 dB/K
Thermal Noise, C/No	85.5 dBHz	Thermal Noise, C/No	63.7 dBHz
C/(No+lo)	85.0 dBHz	C/(No+lo)	63.2 dBHz
Satellite		Satellite	
Flux Density	-99.4 dBW/m2	Flux Density	-121.4 dBW/m2
SFD @ Hub	-88.1 dBW/m2	SFD @ Terminal	-88.8 dBW/m2
Small Signal Gain (IBO/OBO)	2.5 dB	Small Signal Gain (IBO/OBO)	2.5 dB
OBO Downlink	8.8 dB	OBO Downlink	30.1 dB
Downlink	11.653 GHz	Frequency	11.149 GHz
Frequency Transponder Sat. EIRP @ Beam Peak	46.5 dBW	Transponder Sat. EIRP @ Beam Peak	46.0 dBW
Transponder Sat. EIRP @ Terminal	45.0 dBW	Transponder Sat. EIRP @ Hub	46.0 dBW
DL PSD Limit	13.0 dBW/4kHz	DL PSD Limit	13.0 dBW/4kHz
DL PSD @ Beam Peak	7.3 dBW/4kHz	DL PSD @ Beam Peak	-16.3 dBW/4kHz
Carrier EIRP @ Beam Peak	37.7 dBW	Carrier EIRP @ Beam Peak	15.9 dBW
Carrier EIRP @ Terminal	36.2 dBW	Carrier EIRP @ Hub	15.9 dBW
Slant Range	38178 km	Slant Range	40858 km
Space Loss, Ls	205.4 dB	Space Loss, Ls	205.6 dB
Pointing Loss, Lpnt	0.0 dB	Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB	Atmosphere / Weather Loss, La	6.7 dB
Radome, Lr	0.5 dB	Radome, Lr	0.0 dB
PCMA Loss	0.0 dB	PCMA Loss	0.0 dB
Thermal Noise, C/No	69.9 dBHz	Thermal Noise, C/No	67.2 dBHz
C/(No+lo)	69.3 dBHz	C/(No+lo)	65.7091 dBHz
End to End		End to End	
End to End C/(No+lo)	69.2 dBHz	End to End C/(No+lo)	61.3 dBHz
Implementation Loss	1.0 dB	Implementation Loss	0.0 dB
End to End C/N w/ Imp Loss	1.7 dB	End to End C/N w/ Imp Loss	-7.0 dB
Link Margin	0.8 dB	Link Margin	0.2 dB

Forward Link Bu	dget
eXConnect Terminal	
Antenna Type	HR129
Lat	19.8 deg
Lon	-135.2 deg
EIRP max	41.9 dBW
G/T	11.1 dB/K
Satellite	
Name	GE-23
Longitude	172.0 deg
Hub Earth Station	
Site	Brewster
Lat	48.1 deg
Lon	-119.8 deg
EIRP max	80.0 dBW
G/T	37.3 dB/K
Signal	
Waveform	DVB-S2
Modulation	QPSK
Bits per symbol	2
Spread Factor	1
Coding Rate	0.80
Overhead Rate	0.92
Channel Spacing	1.20
Spectral Efficiency (Rate/Noise BW)	1.47 bps/Hz
Data Rate	2.21E+07 bps
Information Rate (Data + Overhead)	2.40E+07 bps
Symbol Rate	1.50E+07 Hz
Chip Rate (Noise Bandwidth)	1.50E+07 Hz
Occupied Bandwidth	1.80E+07 Hz
Power Equivelent Bandwidth	2.70E+07 Hz
C/N Threshold	5.1 dB
Uplink	14.303 GHz
Frequency Back off	0.8 dB
EIRP Spectral Density	43.4 dBW/4kHz
Slant Range	41051 km
Space Loss, Ls	207.8 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	6.7 dB
Radome, Lr	0.0 dB
Transponder G/T @ Hub	1.0 dB/K
Thermal Noise, C/No	94.2 dBHz
C/(No+lo)	93.7 dBHz
Satellite	55.7 UDITE
Flux Density	-90.8 dBW/m2
SFD @ Hub	-87.9 dBW/m2
Small Signal Gain (IBO/OBO)	1.9 dB
OBO	1.0 dB
Downlink	5 45
Frequency	11.503 GHz
Transponder Sat. EIRP @ Beam Peak	47.7 dBW
Transponder Sat. EIRP @ Terminal	47.0 dBW
DL PSD Limit	12.5 dBW/4kHz
DL PSD @ Beam Peak	10.9 dBW/4kHz
Carrier EIRP @ Beam Peak	46.7 dBW
Carrier EIRP @ Terminal	46.0 dBW
Slant Range	38896 km
Space Loss, Ls	205.5 dB
Pointing Loss, Lpnt	0.0 dB
Atmosphere / Weather Loss, La	0.0 dB
Radome, Lr	0.5 dB
	0.0 dB
PCMA Loss	
PCMA Loss Thermal Noise, C/No	79.7 dBHz
PCMA Loss Thermal Noise, C/No C/(No+Io)	
PCMA Loss	79.7 dBHz

1.0 dB

5.4 dB 0.3 dB

Implementation Loss End to End C/N w/ Imp Loss Link Margin

#### Return Link Budget

eXConnect Terminal	UD120	
Antenna Type	HR129	
Lat	19.8	-
Lon	-135.2	
EIRP max		dBW
G/T Satellite	11.1	dB/K
Name	GE-23	
Longitude	172.0	deg
Hub Earth Station		0
Site	Brewster	
Lat	48.1	deg
Lon	-119.8	deg
EIRP max	80.0	dBW
G/T	37.3	dB/K
Signal		
Waveform	iDirect	
Modulation	BPSK	
Bits per symbol	1	
Spread Factor	16	
Coding Rate	0.67	
Overhead Rate	0.72	
Channel Spacing	1.20	
Spectral Efficiency (Rate/Noise BW)	0.03	bps/Hz
Data Rate	2.01E+05	bps
Information Rate (Data + Overhead)	2.78E+05	bps
Symbol Rate	4.17E+05	Hz
Chip Rate (Noise Bandwidth)	6.67E+06	Hz
Occupied Bandwidth	8.00E+06	Hz
Power Equivelent Bandwidth	1.03E+05	Hz
C/N Threshold	-9.9	dB
Uplink		
Frequency	14.039	GHz
Back off	0.0	dB
EIRP Spectral Density	9.7	dBW/4kH
Slant Range	38896	km
Space Loss, Ls	207.2	dB
Pointing Loss, Lpnt	0.0	dB
Atmosphere / Weather Loss, La	0.0	dB
Radome, Lr	0.5	dB
Transponder G/T @ Terminal	-1.0	dB/K
Thermal Noise, C/No	61.8	dBHz
C/(No+lo)	61.3	dBHz
Satellite		
Flux Density		dBW/m2
SFD @ Terminal		dBW/m2
Small Signal Gain (IBO/OBO)	1.9	
OBO	32.5	dВ
Downlink	10.000	CHa
Frequency	10.989	dBW
Transponder Sat. EIRP @ Beam Peak		dBW
Transponder Sat. EIRP @ Hub DL PSD Limit		
		dBW/4kl
DL PSD @ Beam Peak		dBW/4kl
Carrier EIRP @ Beam Peak		dBW
Carrier EIRP @ Hub		dBW
Slant Range	41051	
Space Loss, Ls	205.5	
Pointing Loss, Lpnt	0.0	
Atmosphere / Weather Loss, La	6.1	
Radome, Lr	0.0	
PCMA Loss	0.0	
Thermal Noise, C/No		dBHz
C/(No+lo)	64.7749	dBHz
End to End End to End C/(No+Io)	F0.7	dDU-
	59.7 0.0	dBHz
	0.0	ub
Implementation Loss End to End C/N w/ Imp Loss Link Margin	-8.6 1.3	dB